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Surface light emitting device

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Abstract

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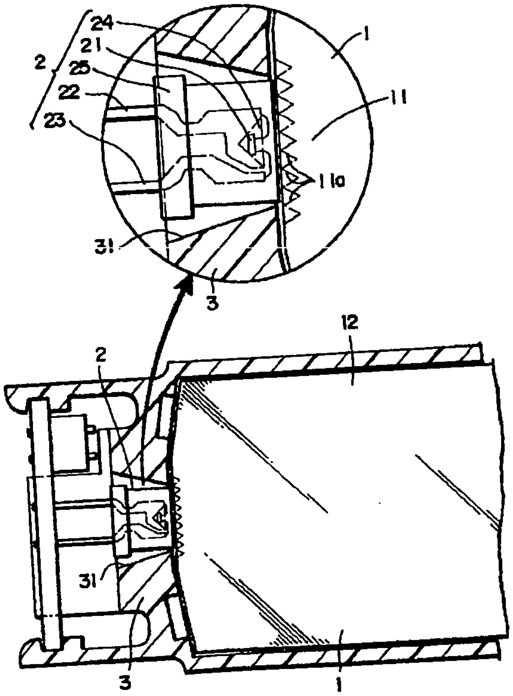
(54)【発明の名称】　面発光装置

(57)【要約】
【課題】　均一性に優れ、高輝度発光可能な面状発光装置を提供する。
【解決手段】　互いに対向する上面と下面を有する導光板と、導光板の下面に設けられた反射体と、少なくとも１つのＬＥＤ素子を有しそのＬＥＤ素子からの光を導光板の一端面から入射するように設けられたＬＥＤ光源とを備え、導光板の上面から光を出射する面発光装置において、導光板は一端面に、ＬＥＤ光源から入射された光を導光板内に分散させるように窪んだ光拡散部を有し、かつ光拡散部を光拡散部の上端が一端面において上面から離れるように形成した。



【特許請求の範囲】

【請求項１】　互いに対向する上面と下面を有する導光板と、該導光板の下面に設けられた反射体と、少なくとも１つのＬＥＤ素子を有しそのＬＥＤ素子からの光を上記導光板の一端面から入射するように設けられたＬＥＤ光源とを備え、上記導光板の上面から光を出射する面発光装置において、

上記導光板は上記一端面に、上記ＬＥＤ光源から入射された光を上記導光板内に分散させるように窪んだ光拡散部を有し、かつ上記光拡散部は、該光拡散部の上端が上記一端面において上記上面から離れて形成されていることを特徴とする面発光装置。

【請求項２】　上記光拡散部は、上記一端面において上記上面から離れた一点を頂点として上記下面に向かって半角錐又は半円錐状に切り欠かれてなる切り欠きである請求項１記載の面発光装置。

【請求項３】　上記切り欠きは、三角錐形状を有する請求項２記載の面発光装置。

【請求項４】　上記切り欠きがＬＥＤ素子一個に対して複数形成されている請求項２又は３に記載の面発光装置。

【請求項５】　上記ＬＥＤ素子一個に対応して形成された複数の切り欠きのうちの隣接する切り欠きが、上記導光板の下面において互いに離れて形成された請求項４記載の面発光装置。

【請求項６】　上記切り欠きはそれぞれ２つの傾斜面を有する三角錐形状であって、上記切り欠きのうちの少なくとも２つの切り欠きを構成する傾斜面はそれぞれ上記一端面に対して異なる角度に形成されている請求項４又は５記載の面発光装置。

【請求項７】　上記複数の切り欠きを構成する各傾斜面はそれぞれ上記一端面に対して互いに異なる角度に形成されている請求項６記載の面発光装置。

【請求項８】　上記光拡散部は、該光拡散部の上端及び下端がそれぞれ上記一端面において上記上面及び上記下面から離れて形成されている請求項１記載の面発光装置。

【請求項９】　上記光拡散部の内面は曲面である請求項８記載の面発光装置。

【請求項１０】　上記光拡散部の内面は球面である請求項９記載の面発光装置。

【請求項１１】　上記光拡散部は半円柱形状である請求項９記載の面発光装置。

【請求項１２】　上記ＬＥＤ素子は、透光性樹脂で覆われている請求項１～１１のうちのいずれか１つに記載の面発光装置。

【請求項１３】　上記面発光装置は、上記導光板の上記一端面に対向配置される面と該面に形成された凹部であって上記ＬＥＤ素子が設けられて透光性樹脂が充填されてなる発光部とを有してなるＬＥＤバー光源を備え、上記光拡散部は上記発光部の出射面と対向するように設けられたことを特徴とする請求項１～１１のうちのいずれか１つに記載の面発光装置。

【請求項１４】　上記ＬＥＤバー光源は、複数の発光部を有する請求項１３に記載の面発光装置。

【請求項１５】　上記透光性樹脂は、上記ＬＥＤ素子が発生する光を吸収してその吸収した光の波長とは異なる波長の光を発生する蛍光体を含む請求項１２～１４のうちのいずれか１つに記載の面発光装置。

【請求項１６】　上記ＬＥＤ素子は、可視光が発光可能な発光素子であり、上記蛍光体は上記発光素子からの可視光を吸収し、その吸収した光よりも長波長の可視光が発光可能な蛍光物質である請求項１５記載の面発光装置。

【請求項１７】　上記発光部は、上記ＬＥＤ素子が発生する光と上記蛍光体が発生する光との混色による白色光を上記出射面から出力する請求項１５又は１６記載の面発光装置。

【請求項１８】　上記ＬＥＤ素子は窒化物半導体を有してなり、上記蛍光体はセリウムで付活されたイットリウム・アルミニウム・ガーネット蛍光体である請求項１５～１７記載の面発光装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、点光源であるＬＥＤチップから入射される光を導光板の発光面で均一に発光させることが可能で、液晶バックライト、パネルメーター、表示灯や面発光スイッチなどに用いられる面発光装置に関する。

【０００２】

【従来の技術】近年、液晶バックライトなどの光源として、点光源であるＬＥＤチップからの光を面状に発光させる面発光装置が用いられている。この面発光装置は、対向する主面を有する導光板の一端面から１又は２以上の発光ダイオードからの光を入射してその導光板の一方の主面全体から光を出射させるように構成される。この面発光装置においては、その出射面から均一に光を出力することが重要であり、この均一性を実現するために種々の構造が提案されている。その提案された従来例の面発光装置の一例を、図１９に模式的に示す。図１９の面発光装置は、第１の主面と第２の主面とを有し光を透過させることができる透過性樹脂からなる導光板９０１と、その導光板９０１の端面に対向配置されＬＥＤ素子が内部にモールドされてなるＬＥＤモールド部９０２と、導光板の第２の主面側に設けられ第１の主面側から光を放出させるように光を反射させる反射体９０４とを有している。

【０００３】この図１９の面発光装置では、導光板９０１の入射端面に半円柱形状の切り欠き９１１を形成することにより、導光板９０１の主面に平行な面方向に均一

に光が分散して入力されるように構成し、これによりＬＥＤ素子から入力された光が第１の主面から出力される面状発光の均一化を図っている。

【０００４】

【発明が解決しようとする課題】しかしながら、図１９の従来例の面発光装置では、導光板の第１の主面において切り欠き部９１１の近傍にが極端に明るくなってしまうという問題点があった。また、図１９の従来例の面発光装置は、切り欠き部９１１によって一定の面内均一化は図られているものの、まだ十分ではなかった。

【０００５】そこで、本発明は上記の問題を解決して、より均一性に優れ、高輝度発光可能な面状発光装置を提供することを目的とする。

【０００６】

【課題を解決するための手段】本発明者は種々の実験検討の結果、導光板端面に所定の形状の光拡散部を形成することにより、導光板端部から入射する光を導光板内により均一に拡散させることができることを見いだし、本発明を成すに至った。

【０００７】すなわち本発明の面発光装置は、互いに対向する上面と下面を有する導光板と、該導光板の下面に設けられた反射体と、少なくとも１つのＬＥＤ素子を有しそのＬＥＤ素子からの光を上記導光板の一端面から入射するように設けられたＬＥＤ光源とを備え、上記導光板の上面から光を出射する面発光装置において、上記導光板は上記一端面に、上記ＬＥＤ光源から入射された光を上記導光板内に分散させるように窪んだ光拡散部を有し、かつ上記光拡散部は、該光拡散部の上端が上記一端面において上記上面から離れて形成されていることを特徴とする。このように構成された面発光装置において、上記光拡散部は、該上端が上記導光板の一端面において、導光板の上面に開口部が形成されないように導光板の上面から離れて形成されているので、上記導光板の上面から直接光が漏れるのを防止することができ、異常発光のない均一な面発光をさせることができる。ここで、導光板の上面とは、発光させる面のことをいい、下面とは発光面の反対側の面をいう。

【０００８】また、本発明の面発光装置において、上記光拡散部は、入射された光を効率良く導光板の上面において発光させるために、上記一端面において上記上面から離れた一点を頂点として上記下面に向かって半角錐又は半円錐状に切り欠かれてなる切り欠きであることが好ましい。

【０００９】また、本発明の面発光装置において、上記切り欠きは、三角錐形状であることが好ましい。

【００１０】また、本発明の面発光装置において、ＬＥＤ光源から入射される光を導光板の上面において効率良く発光させるために、上記切り欠きがＬＥＤ素子一個に対して複数形成されていることが好ましい。

【００１１】また、本発明の面発光装置において、上記ＬＥＤ素子一個に対応して形成された複数の切り欠きのうちの隣接する切り欠きが、上記導光板の下面において互いに離れて形成されるようにしてもよい。このようにすると、切り欠き間に比較的面積の大きい平坦部を形成することができ、これにより入射する光のうち切り欠きに入射する光は拡散され、平坦面に入射する光は前方に伝搬されるので、比較的長い形状の面発光装置において均一な面状発光をさせることができる。

【００１２】さらに、本発明の面発光装置において、ＬＥＤ光源からの光がより拡散されて導光板に入射されるように、上記切り欠きはそれぞれ２つの傾斜面を有する三角錐形状であって、上記切り欠きのうちの少なくとも２つの切り欠きを構成する傾斜面はそれぞれ上記一端面に対して異なる角度に形成されていることが好ましい。

【００１３】また、本発明の面発光装置において、ＬＥＤ光源からの光がよりいっそう拡散されて導光板に入射されるように、上記複数の切り欠きを構成する各傾斜面はそれぞれ上記一端面に対して互いに異なる角度に形成されていることが好ましい。

【００１４】また、本発明の面発光装置において、ＬＥＤ光源からの光が導光板の上面および下面から漏れるのを防止するために、上記光拡散部は、該光拡散部の上端及び下端がそれぞれ上記一端面において上記上面及び上記下面から離れて形成されるようにしてもよい。

【００１５】また、本発明の面発光装置において、上記光拡散部の内面は曲面であってもよい。

【００１６】さらに、本発明の面発光装置において、上記光拡散部の内面は球面であってもよい。

【００１７】また、本発明の面発光装置において、上記光拡散部は半円柱形状であつてもよい。

【００１８】さらに、本発明の面発光装置において、上記ＬＥＤ素子は、透光性樹脂で覆うこともできる。

【００１９】また、本発明の面発光装置は、上記導光板の上記一端面に対向配置される面と該面に形成された凹部であって上記ＬＥＤ素子が設けられて透光性樹脂が充填されてなる発光部とを有してなるＬＥＤバー光源を備えていてもよく、この場合、上記光拡散部は上記発光部の出射面と対向するように設けられる。

【００２０】また、本発明の面発光装置において、上記ＬＥＤバー光源は、複数の発光部を備えていてもよい。これによって、広い面積の面発光でも輝度が十分な面発光装置とすることができる

【００２１】さらに、本発明の面発光装置において、上記透光性樹脂は、上記ＬＥＤ素子が発生する光を吸収してその吸収した光の波長とは異なる波長の光を発生する蛍光体を含んでいてもよい。

【００２２】また、本発明の面発光装置において、上記ＬＥＤ素子を可視光が発光可能な発光素子とし、上記蛍光体を上記発光素子からの可視光を吸収し、その吸収した光よりも長波長の可視光が発光可能な蛍光物質とする

ことができる。本構成において、ＬＥＤ素子と蛍光体との種々の組み合わせによって、任意の色調の発光色を視認させることができる。

【００２３】また、本発明の面発光装置において、上記発光部は、上記ＬＥＤ素子が発生する光と上記蛍光体が発生する光との混色による白色光を上記出射面から出力するように構成することができる。

【００２４】上記面発光装置において、上記ＬＥＤ素子を窒化物半導体を有してなるＬＥＤとし、上記蛍光体をセリウムで付活されたイットリウム・アルミニウム・ガーネット蛍光体とすることにより、白色光を上記出射面から出力するように構成することができる

【００２５】

【発明の実施の形態】本発明の面発光装置は、ＬＥＤ光源から放出された光を導光板に導入して面状に発光させるものである。本面発光装置は、その用途や目的に応じて使用する導光板の形状を選択することができ、例えば、パソコン等の液晶のバックライトに用いる場合は略矩形の平板状の導光板が用いられ、また、自動車のパネルメーターのバックライト等に用いる場合はそのデザインに応じた形状の導光板が用いられる。以下、図面を参照しながら、本発明に係る実施の形態の面発光装置について説明する。

【００２６】実施の形態１．本発明に係る実施の形態１の面発光装置は、図１、図２に示すように、対向する主面の一方の面である下面に反射層４を備え他方の面を発光面１２とする導光板１と、導光板１の一端面である入射端面にその出射面が対向するように配置されたＬＥＤ光源２と、例えば樹脂成形体からなり、導光板１とＬＥＤ光源２とを所定の位置関係で保持する支持体３とを備えている。ここで、特に本実施の形態１の面発光装置は、導光板１の入射端面におけるＬＥＤ光源２の出射面２６と対向する部分に、複数の三角錐形状の切り欠き１１ａを有する光拡散部１１を形成したことを特徴とし、これにより、導光板１の発光面１２における光拡散部１１の近傍の異常発光を抑制できかつ発光面１２における発光強度の面内分布の均一性を向上させることができる。

【００２７】詳細に説明すると、本実施の形態１の面発光装置において、ＬＥＤ光源２は、図１、図３に示すようにリードフレーム２２の先端部に形成されたカップ２２ａ内にＬＥＤチップ（ＬＥＤ素子）２１が設けられ、そのカップ内に蛍光体を含む透光性樹脂２４が充填され、その全体が透光性樹脂２５を用いてモールドされてなる。ここで、透光性樹脂２５は、図３に示すようにその出射面２６が平坦になるようにモールドされる。また、ＬＥＤチップ２１の正負の電極のうちの一方の電極はリードフレーム２２に接続され、他方の電極はリードフレーム２２に近接して設けられたリードフレーム２３に接続される。

【００２８】本実施の形態１において、導光板１は透光性樹脂が例えば射出成形により成形されてなり、図２に示すように、その一端面１０に複数の三角錐形状の切り欠き１１ａが形成されて、その複数の切り欠き１１ａにより光拡散部１１が構成されている。この切り欠き１１ａは、導光板１の端面１０において発光面１２から離れた一点を頂点として反射層４が形成された下面に向かって広がるように三角錐状に形成されている。尚、図２において２６ａの符号を付して２点鎖線で示す部分は、端面１０においてＬＥＤ光源２の出射面２６と対向させる部分である。

【００２９】また、実施の形態１において、支持体３は、図１に示すようにＬＥＤ光源２の出射面２６と導光板１の光拡散部１１とを近接して対向させるようにＬＥＤ光源２と導光板１とを位置決めして固定する。尚、支持体３においてＬＥＤ光源２を配置する素子配置部３１は、その開口部分がＬＥＤ光源２の出射面２６と実質的に同一形状になるように形成され、これにより、ＬＥＤ光源２の出射面２６以外の部分から漏れた光が、光拡散部１１以外の部分から導光板１に入力されるのを防止している。すなわち、この素子配置部３１は、ＬＥＤ光源２を所定の位置に配置するとともに、ＬＥＤ光源２からの光が光拡散部１１のみから導光板１に入射されるように光路を制限している。

【００３０】以上のように構成された実施の形態１の面発光装置においては、導光板１の光拡散部１１が複数の三角錐形状の切り欠き１１ａを備えて構成されているので、以下のような作用効果を有する。すなわち、三角錐形状の切り欠き１１ａは、端面１０に対して傾斜した二つの面（以下、第１傾斜面と第２傾斜面という。）を有しているので、第１傾斜面及び第２傾斜面に一定の角度（全反射角）より小さい入射角（光の進行方向と面の法線との成す角度）で入射した光は、その入射角に応じた屈折角で導光板１の中に入射される。この時、第１傾斜面と第２傾斜面はそれぞれ端面１０に対して内側に傾斜しているので傾斜している分だけ、第１傾斜面と第２傾斜面から入射された光は導光板１の側面方向に広がって導光板１内に入射される。また、全反射角より大きい入射角で一方の第１傾斜面又は第２傾斜面に入射した光は、第１傾斜面又は第２傾斜面で全反射されて全反射された光はそれぞれ、他方の第２傾斜面又は第１傾斜面から導光板１内に入射される。このようにして、光拡散部１１に入射された光は、図８（ａ）に模式的に示すように、拡散されて導光板１内に入射され、その結果、導光板１の発光面１２における発光輝度の均一性を向上させることができる。

【００３１】また、本実施の形態１の面発光装置において、切り欠き１１ａは、導光板１の端面１０において発光面１２から離れた一点を頂点として反射層４が形成された下面に向かって三角錐状に形成されている。すなわ

ち、切り欠き１１ａは、発光面１２において開口部を有していないので、図８（ｂ）に示すように、発光素子２から出射された光が直接、発光面から出射されるのを防止することができる。これにより、従来例のように、導光板とＬＥＤの間にできた隙間（開口部）から光が漏れて直接視認されることにより生じる、その部分だけが極端に明るくなるという異常発光を防止することができる。

【００３２】また、切り欠き１１ａは、下面に向かって広がるように三角錐状に形成されているので、第１第２傾斜面が下方に向いて形成され、導光板１の端面に対し垂直に入射した光を下面方向に屈折させることができる。これにより、導光板１の端面１０に対して垂直に入射した光を導光板の下面に設けられた反射層４により上方に反射させて発光面１２から出力することができるので、発光面からより効果的に出力することができる。すなわち、導光板１の端面１０に対して垂直に入射した光は、比較的強度が高い光であるが、従来例のような構造であると端面に対して垂直に入射された光が導光板内を発光面に対して平行に進行し、他方の端面から出力され発光面から出力される光として有効に利用されない率が高くなる。これに対して、本実施の形態１のように、第１第２傾斜面が下方に向いて形成されていると、導光板１の端面１０に対して垂直に入射した光を導光板の下面に設けられた反射層４に向けて屈折させて入射することができ、反射層４で反射した光を発光面から出力することができる。

【００３３】以上のように本実施の形態１の面発光装置は、図１７に示すように、発光面１２の一部が極端に明るくなるというような異常発光がなく、かつ発光面内において均一な発光を観測することができる。また、ＬＥＤ光源からの光を外部に漏らすことなく導光板１内に入射することができるので、効率よく光を利用でき面全体の発光輝度を高くすることができる。尚、図１８は、従来例の導光板を用いた場合の発光面における発光の様子を示す図である。この図１８では、導光板の光拡散部近傍において顕著な異常発光が観測されている。

【００３４】実施の形態２．次に、本発明に係る実施の形態２の面発光装置について説明する。本実施の形態２の面発光装置は、図４に示すように、ＬＥＤバー光源１００と導光板１０１とを備えている。実施の形態２において、ＬＥＤバー光源１００は、図４、図５に示すように、複数の発光部１０２を有し、その発光部１０２は、例えば、樹脂成形体からなるバー本体部１２５の側面に形成された凹部１３１にＬＥＤチップ２１が設けられて透光性樹脂１２４が充填されてなる。ここで、透光性樹脂１２４は、ＬＥＤチップ２１が発生する光を吸収してその吸収した光の波長とは異なる波長の光を発生する蛍光体を含み、ＬＥＤチップ２１が発生する光と蛍光体からの光との混色により所望の色の光を出射面１２６から出力する。

【００３５】また、実施の形態２の面発光装置において、導光板１０１は透光性樹脂が例えば射出成形により成形されてなり、その一端面がＬＥＤバー光源１００の複数の発光部１０２が形成された側面に対向配置される。そして、その導光板１０１の一端面には、図６に示すように発光部１０２と対向する部分に複数の三角錐形状の切り欠き１１１ａが形成されて、それぞれ複数の切り欠き１１１ａからなる２つの光拡散部１１１が形成される。尚、図６において１２６ａの符号を付して２点鎖線で示す部分は、発光部１０２の出射面１２６と対向させる部分である。ここで、本実施の形態２における切り欠き１１１ａは、実施の形態１と同様に、導光板１０１の一端面において発光面である上面から離れた一点を頂点として反射層が設けられる下面に向かって三角錐状に形成される。

【００３６】以上のように構成された実施の形態２の面発光装置は、実施の形態１と同様の作用効果を有し、かつ複数の発光部１０２を備えているので、より発光面積の大きい面発光装置を構成することができる。尚、図４等において２つの発光部１０２を示しているが、本発明はこれに限られるものではなく、ＬＥＤバー光源が２以上の発光部を有していてもよい。

【００３７】＜変形例＞以下、本発明に係る変形例について説明する。

変形例１．本発明に係る変形例１の面発光装置は、図７に示すように、実施の形態２の面発光装置の導光板１０１において、複数の切り欠き１１１ａに代えて１つの三角錐形状の切り欠き１０５により光拡散部を構成した以外は、実施の形態２の面発光装置と同様に構成される。尚、この変形例１の面発光装置における三角錐形状の切り欠き１０５は、実施の形態１及び実施の形態２の切り欠き１１ａ，１１１ａに比較して大きく形成される。また、本変形例１の面発光装置において、切り欠き１０５は、導光板１０１の端面において発光面から離れた一点を頂点として反射層４が形成された下面に向かって三角錐状に形成される。

【００３８】以上のように構成された変形例１の面発光装置は、切り欠き１０５が端面１０に対して傾斜した二つの面を有しているので、実施の形態１で説明したように、２つの傾斜面から入射された光は導光板１０１の側面方向に拡散されるように導光板１内に入射される（図８（ａ））。したがって、１つの切り欠き１０５を備えた導光板１０１を用いても、導光板１０１の発光面における発光輝度の均一性を向上させることができる。

【００３９】また、切り欠き１０５は、発光面１２において開口部を有していないので、図８（ｂ）に示すように、発光部１０２から出射された光が直接、発光面１２から出射されるのを防止することができる。これにより、従来例のように、導光板とＬＥＤの間にできた隙間

（開口部）から光が漏れて直接視認されることにより生じる、その部分だけが極端に明るくなるという異常発光を防止することができる。

【００４０】また、切り欠き１０５は、下面に向かって広がるように三角錐状に形成されているので、その２つの傾斜面が下方に向いて形成され、導光板１０１の端面１０４に対して垂直に入射した光を下面に向かって屈折させることができる。これにより、導光板１０１の端面１０４に対して垂直に入射した光を導光板の下面に設けられた反射層１０３により上方に反射させて発光面から出力することができるので、発光面からより効果的に出力することができる。

【００４１】以上説明したように、本発明に係る変形例１の面発光装置は、実施の形態１及び２と同様の作用効果を有するが、以下の点においてその作用効果が異なる。

（１）変形例１の面発光装置において、導光板１０１の切り欠き１０５が１つであることから、導光板１０１を作製するための金型の構造を簡単にでき、金型を安価に作製できる。これにより、導光板１０１を安価にできる。

（２）変形例１の面発光装置において、導光板１０１の切り欠き１０５が１つであることから、切り欠き１０５を実施の形態１及び２の切り欠き１１ａ，１１１ａに比較して必然的に大きく形成する必要がある。これにより、切り欠き１０５による空間を介して導光板１０１の下方に漏れる光の量が大きくなる。したがって、光源からの光を効果的に発光面から発光させるという観点では、実施の形態１及び２の複数の切り欠きから光拡散部を構成する構造が優れている。

【００４２】（３）また、三角錐形状の切り欠きは、プリズムとして機能して光源から入力される光を例えば青と黄色に分光させる場合がある。この場合、複数の切り欠きにより入射部が構成された実施の形態１及び２では、ある切り欠きにより分光されて入力された光が他の切り欠きから分光されて入力された光と混合されることにより、この分光現象を実質的になくすことができる。したがって、この分光現象が問題となる用途には、切り欠きを複数形成することにより光拡散部を構成した実施の形態１及び２の構造が優れている。また、拡散効果は切り欠きの形状によって決定されるが、切り欠きをＬＥＤ一個について複数形成すると、拡散効果を高めるために数を変更することができ光の拡散効果がより高くなるように数を設定することができる。

【００４３】変形例２．実施の形態１及び２では、隣り合う切り欠き１１ａ，１１１ａが、導光板１，１０１の下面で接するように形成したが、本発明はこれに限られるものではなく、図９に示すように、隣接する切り欠きが下面において互いに離れて形成されていてもよい。このように、隣接する切り欠き間に位置する平坦面の面積及び形状を含め光拡散部全体で最も効率よく光を拡散させて導光板内に入力するようにデザインすることもできる。例えば、図９に示すように、切り欠き部２１１ａ間に実施の形態１及び２に比較して幅の広い平坦面を設けると、切り欠き２１１ａに入射される光は拡散されて光入射端面側の隅部に光を伝搬させることができるとともに、平坦面に入射する光は光入射端面と反対側の端面に向けて伝搬させることができるので、ＬＥＤから離れた部分の輝度の低下を抑制できる。したがって、本変形例２の構成は、導光板の形状が、光入射端面が短辺で、光入射端面の側面が長辺となるような長細い形状である場合等では特に有効であり、ＬＥＤ光源から遠い側の輝度が低下するのを少なくすることができる。

【００４４】変形例３．複数の切り欠きにより光入射面を構成する場合、切り欠きの形状は互いに異なっていてもよい。例えば、二つの平面からなる三角錐形状の切り欠き部を複数設ける場合、図１０に示すように、光源のＬＥＤ素子（チップ）から遠ざかるに従って切り欠きの側壁の角度を変化させてもよい。図１０に示す例では、ＬＥＤ素子の正面に対向する、光拡散部の中央部に位置する切り欠き部３１１ａは、、導光板端面に対してほぼ同じ角度で形成され、中央部から遠ざかるに従って、切り欠き３１１ａの外側側壁と導光板端面との成す角度は直角に近づき、逆に内側側壁と導光板端面との成す角度は小さくなるように変化している。このようにすると、光をより広く拡散させることができるので、入射端面の隅部にまで光を伝搬させることができる。したがって、比較的幅の広い導光板を用いる場合に有効である。以上の変形例３では、光拡散部３１１において、中央に位置する切り欠き３１１ａから離れるに従って順次、側壁の角度が変化するようにした例を示したが、本発明はこれに限られるものではなく、ランダムに角度を変化させても良い。また、図１０では、光拡散部３１１を構成する複数の切り欠き３１１ａの全ての傾斜面の端面に対する角度が互いに異なるように形成した（任意に選んだ２つの切り欠き３１１ａの傾斜面の角度が互いに異なるように形成）が、本変形例３はこれに限られるものではない。すなわち、本発明では、複数の切り欠き３１１ａのうちの少なくとも２つの切り欠きの傾斜面の端面に対する角度が異なるように構成すれば、本変形例３と同様の効果が得られる。

【００４５】変形例４．実施の形態１及び２の面発光装置では、三角錐形状の切り欠きを形成するようにしたが、本発明は三角錐形状に限られるものではなく、図１１に示すように、半円錐形状の切り欠き４１１ａを用いて光拡散部４１１を形成するようにしてもよい。以上のようにしても、実施の形態１及び２と同様の作用効果を有する。しかしながら、半円錐形状の切り欠き４１１ａは、三角錐状の切り欠きに比較して導光板の下面における切り欠きによる開口面積が若干大きくなるので、その部分からの光の漏れが若干大きくなる。

【００４６】変形例５．また、本発明の面発光装置では、図１２に示すように、半円錐台形状の切り欠き５１１ａを用いて光拡散部５１１を形成するようにしてもよい。以上のようにしても、実施の形態１及び２と同様の作用効果を有する。また、変形例５において、半円錐台形状の切り欠き５１１ａは、その上面が導光板の上面（発光面）から離れて形成されているとともに、その下面も導光板の下面から離れて形成されている。この様に形成された切り欠き５１１ａは、導光板の上面（発光面）及び下面において開口部分を有していないので、導光板の発光面における異常発光を防止できるとともに、導光板の下面からの光の漏れを防止することができる。

【００４７】変形例６．また、本発明の面発光装置では、図１３に示すように、半円柱形状の切り欠き６１１ａを用いて光拡散部６１１を形成するようにしてもよい。ここで、切り欠き６１１ａは、導光板の発光面と略平行な上端面を有し、導光板の下面のみで開口している。尚、本変形例６では、切り欠き６１１ａを互いに接するように形成したが、本発明はこれに限らず、図１４に示すように、互いに間隔を空けて形成することにより光拡散部６１２を形成するようにしてもよい。以上のようにしても、実施の形態１及び２と同様の作用効果を有する。

【００４８】変形例７．以上の実施の形態１及び２では、切り欠き１１ａ，１１１ａを形成するようにしたが、本発明はこれに限らず、図１５に示すように、導光板５０１の端面５０４に半球状の窪み５０５を形成するようにしてもよい。尚、本変形例７では、窪み５０５はその上端及び下端のいずれもが端面５０４の上端辺５０６及び下端辺５０７からそれぞれ離れて形成されるように形成している。このようにすると、ＬＥＤ光源からの光は、導光板の発光面（上面）から直接漏れることがないので、発光面における異常発光を防止できる。また、本変形例７では、導光板の下面からも光が直接漏れることがないので、入射光は導光板内で効率よく発光面から放出される。また、本変形例７では、図１６に示すように、半球形状の窪み５０５ａを複数形成するようにしてもよい。

【００４９】以上実施の形態１，２及び変形例１～７により詳細に説明したように、本発明の面発光装置は、導光板端面に１又は２以上の切り欠き部又は窪みを形成し、かつ少なくともその切り欠き又は窪みの上端が発光面から離れるように形成していることを最小限の要件とし、これにより入射される光を導光板内に拡散させて入力するとともに発光面における異常発光を防止している。尚、本明細書において、切り欠き及び窪みを総称して光拡散部という。すなわち、本発明において切り欠き又は窪みは上述の最小限の要件を備えている限り、錐体状、柱体状、又は錐体の頂点部を平面又は曲面で切り取った形状等種々の形状とすることができる。ここで、錐体状とは、円錐・角錐のように、底面と、底面の外周と一定点（頂点）とを結ぶことによってつくられる曲面又は平面からなる形状のことであり、その頂点は導光板の端面上にあってもよいし、導光板端面の内側又は外側にあってもよい。又、柱体状とは円柱や角柱のように、底面から立てられた平行な母線によって囲まれた形状のことである。

【００５０】本発明に係る面発光装置は上述のように、種々の形状の光拡散部の中から、導光板の形状に応じて最も適切な形状を選択して、より効果的に入射光を拡散させるように構成できる。この場合、光拡散部の数を増やし面の数を増加させると、光をより複雑に反射させることができ、輝度の均一性を向上させることができるが、金型構造が複雑となり、その結果その金型により作製される導光板の端面の形状が一定しなくなる等の問題も生じることもある。そのため、使用目的による要求仕様に加え、製造条件も考慮して用いる形状を選択することが好ましい。

【００５１】すなわち、本発明では種々の形状を選択することができるので、光拡散部として切り欠き及び窪みのいずれを選択するかは、目標とする性能、金型の製作上の制約（製作精度及び製作コスト等）及び成形精度等を総合的に検討して決定することができる。

【００５２】以下、本発明に係る面発光装置における各要素に関する好ましい材料等について説明する。

（導光板）本発明において導光板に用いられる材料としては、光透過性、成形性に優れたものを用いることが好ましく、アクリル樹脂、ポリカーボネート樹脂、非晶性ポリオレフィン樹脂、ポリスチレン樹脂等が挙げられる。これらの導光板用の材料はそれぞれ屈折率が異なるが、導光板端面に形成する切り欠きや窪みの形状、更にはその数等を選定することによって、光の拡散を制御することができるので、いかなる屈折率の材料にも対応できる。

【００５３】（ＬＥＤ光源）本発明のＬＥＤ光源において、１又は２以上のＬＥＤチップを用いることができる。また、ＬＥＤチップからの光を直接導光板に入射するようにしても良いし、例えば可視光の発光が可能なＬＥＤチップと、ＬＥＤチップからの可視光を吸収してそれよりも長波長の可視光が発光可能な蛍光物質とを組み合わせて、ＬＥＤチップから出力される光とは波長の異なる光を導光板内に入射するようにしてもよい。すなわち、本発明において、ＬＥＤチップを蛍光体と組み合わせて用いることにより、発光素子と蛍光物質の組み合わせによって、様々な色調の混合色を発光させることが可能である。以下、液晶のバックライト等に最もよく用いられ、需要が高い白色発光ＬＥＤついて、窒化物半導体を有してなり青色の発光が可能なＬＥＤチップと、セリウムで付活されたイットリウム・アルミニウム・ガーネット蛍光体を用いた例について説明する。

【００５４】（ＬＥＤチップ）ここで用いることができる、窒化物系化合物半導体（一般式$In_iGa_jAl_kN$、但し、$0 \leqq i$、$0 \leqq j$、$0 \leqq k$、$i+j+k=1$）としては、ＩｎＧａＮや各種不純物がドープされたＧａＮをはじめ、種々のものがある。このＬＥＤチップは、ＭＯＣＶＤ法等により基板上にＩｎＧａＮやＧａＮ等の半導体を発光層として成長させることにより形成する。半導体の構造としては、ＭＩＳ接合、ＰＩ接合やＰＮ接合などを有すホモ構造、ヘテロ構造あるいはダブルヘテロ構造のものが挙げられる。この窒化物半導体層は、その材料やその混晶度によって発光波長を種々選択することができる。また、半導体活性層を量子効果が生ずる薄膜で形成した単一量子井戸構造や多量子井戸構造とすることもできる。本発明において、ＬＥＤチップとしては、青色発光可能な半導体発光層を有し、後述するセリウムで付活されたイットリウム・アルミニウム・ガーネット系蛍光体を効率よく励起できるＬＥＤチップを用いることが好ましい。

【００５５】（蛍光体）本発明の面発光装置に用いる蛍光物質の例としては、可視光や紫外線で励起されて発光するフォトルミネッセンス蛍光体がある。具体的なフォトルミネッセンス蛍光体例としては、青色系が発光可能な窒化物半導体ＬＥＤチップからの光との補色により白色系が発光可能な蛍光物質としてセリウムで付活されたイットリウム・アルミニウム・ガーネット系蛍光体が挙げられるが、$Mg_5Li_6Sb_6O_{13}:Mn$や、$Mg_2TiO_4:Mn$等の蛍光体やこれら蛍光物質を複数混合した蛍光物質をも利用することができる。ここで、より好適な蛍光物質としてセリウムで付活されたイットリウム・アルミニウム・ガーネット系蛍光体について以下に示す。

【００５６】本発明において、セリウムで付活されたイットリウム・アルミニウム・ガーネット系蛍光体は特に広義に解釈するものとしイットリウムの一部あるいは全体をＬｕ、Ｓｃ、Ｌａ、Ｇｄ及びＳｍからなる群から選ばれる少なくとも１つの元素に置換し、あるいは、アルミニウムの一部あるいは全体を、ＧａとＩｎの何れか又は両方で置換する蛍光作用を発する蛍光体を含む意味に使用する。

【００５７】更に詳しくは、一般式$(Y_zGd_{1-z})_3Al_5O_{12}:Ce$（但し、$0<z \leqq 1$）で示されるフォトルミネッセンス蛍光体や一般式$(Re_{1-a}Sm_a)_3Re'_5O_{12}:Ce$（但し、$0 \leqq a<1$、Ｒｅは、Ｙ、Ｇｄ、Ｌａ、Ｓｃから選択される少なくとも一種、Ｒｅ'は、Ａｌ、Ｇａ、Ｉｎから選択される少なくとも一種である。）で示されるフォトルミネッセンス蛍光体である。

【００５８】

【実施例】（実施例１）本発明の実施例１の面状発光装置は、実施の形態２で用いた図６に示す導光板を用いた例である。この導光板の材料としてポリカーボネートを用い、導光板形成用の金型は、導光板端面の第２の主面（下面）側に２つの平面からなる錐体状の切り欠き部１１１ａが８個並んだものが２カ所形成されるようにしてある。また、その金型は、導光板の第２の主面に発光される光の均一性を向上させるための凹凸（シボ）加工が施されるように作製される。導光板の成形は、まず、成形温度を２８０℃に設定してポリカーボネートを溶融させながら、射出圧力１０００ｋｇｆ／ｃｍ２、金型温度は１００℃で射出成型する。そして、４５秒間冷却した後、金型から取り出す。このようにして導光板を形成した。こうして得られた導光板には、導光板から面状に光を取り出す第１の主面（発光面）及び導光板に光を導入する端面を除いて反射シートを設置する。又、反射シートの設けられていない導光板の端面には、白色発光が可能な窒化物半導体からなるＬＥＤチップ２個を有したＬＥＤ光源を配置する。こうして得られた面発光装置のＬＥＤチップに電流を流すと、光が導光板の端面から入射され、導光板の第１の主面から面状に発光させることができる。形成された面状発光装置は、一部が極端に明るい異常発光は認められず、発光輝度も向上させることができる。

【００５９】（実施例２）導光板の材料としてアクリル樹脂を使用し、導光板端面に図１６に示すような球状の３つの窪みが実施例１のように２カ所に形成されるような金型を用い、成型温度を２５０℃、射出圧力１１００ｋｇｆ／ｃｍ２、金型温度８０℃、冷却時間を約３０秒として成型した。上述した以外は実施例１と同様にして、本発明の実施例２の面状発光装置を形成する。このようにして得られた面状発光装置において、ＬＥＤチップに電流を流して面状発光させると、一部が極端に明るい異常発光は認められず、発光輝度も向上させることができる。また、実施例２の面発光装置は、色ムラも少なく均一性に優れたものとできる。

【００６０】（実施例３）導光板の材料としてアクリル樹脂を使用し、導光板端面に図９に示すような、隣接する切り欠きの間が導光板の下面においても離れた導光板が形成されるような金型を用い、成形温度２５０℃、射出圧力１１００ｋｇｆ／ｃｍ２、金型温度８０℃、冷却時間を約３０秒として成型する。上述以外は実施例１と同様にして、本発明の実施例３の面状発光装置を形成する。この実施例３の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、一部が極端に明るい異常発光は認められず、また、平坦面を設けたことで光入射端面から離れた部分の輝度も向上させることができる。

【００６１】（実施例４）導光板の材料としてアクリル樹脂を使用し、導光板端面に図１０に示すようなＬＥＤから遠ざかるに従って切り欠きの面の角度を変化させた錐体状の切り欠き部が９個並んだものが、実施例１のよ

うに二カ所に形成されるような金型を用い、成形温度を２５０℃、射出圧力１１００ｋｇｆ／ｃｍ2、金型温度８０℃、冷却時間を約３０秒として成型する。上述以外は実施例１と同様にして、実施例４の面状発光装置を形成する。この実施例３の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、一部が極端に明るい異常発光は認められず、輝度も向上させることができる。光入射端面側の隅部は、実施例１よりも明るく、より均一な面状発光を得ることができる。

【００６２】（実施例５）導光板の材料としてアクリル樹脂を使用し、導光板端面に図１３に示すような円柱状の切り欠きが６個並んだものが、実施例１のように２カ所に形成されるような金型を用い、成型温度を３００℃、射出圧力１５００ｋｇｆ／ｃｍ2、金型温度１２０℃、冷却時間を約１分として成型する。上述以外は実施例１と同様にして、本発明の実施例５の面状発光装置を形成する。この実施例５の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、若干の輝度ムラが認められるものの、切り欠き部の側面が曲面であるため混色性がよく、色の均一性を向上させることができる。

【００６３】（実施例６）導光板の材料としてアクリル樹脂を使用し、蛍光体端面に図１４のような円柱状の切り欠き部が平坦部を間に挟みながら導光板の長手方向に沿って４個並んだものが、実施例１のように２カ所に形成されるような金型を用い、成形温度を３００℃、射出圧力１５００ｋｇｆ／ｃｍ2、金型温度１２０℃、冷却時間を約１分として成型する。上述以外は実施例１と同様にして、本発明の実施例６の面状発光装置を形成する。この実施例６の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、若干の輝度ムラが認められるものの、切り欠き部の側面が曲面であるため混色性がよく、色の均一性を向上させることができる。また、平坦部を設けることで、入射端面から離れた部分の輝度も向上させることができる。

【００６４】（実施例７）導光板の材料としてアクリル樹脂を使用し、導光板端面に図１１のような円錐体状の切り欠き部が６個並んだものが、実施例１のように２カ所に形成されるような金型を用い、成型温度を２２０℃、射出圧力６００ｋｇｆ／ｃｍ2、金型温度５０℃、冷却時間を約３０秒として成型する。上述以外は実施例１と同様に行い、本発明の実施例７の面状発光装置を形成する。この実施例７の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、切り欠き部の側面が曲面であるため混色性がよく、色の均一性を向上させることができ、また、輝度ムラは柱体状の切り欠き部のものより優れている。

【００６５】（実施例８）導光板の材料としてアクリル樹脂を使用し、導光板端面に図１２に示すような円錐の頂点部分を切り取ったような形状の窪みが６個並んだものが、実施例１のように２カ所に形成されるような金型を用い、成型温度を２５０℃、射出圧力１２００ｋｇｆ／ｃｍ2、金型温度８０℃、冷却時間を約３０秒として成型する。上述以外は実施例１と同様にして、本発明の実施例８の面状発光装置を形成する。この実施例３の面発光装置において、ＬＥＤチップに電流を流して面状発光させると、輝度ムラは注体状のものより優れ、また、切り欠き部の側面が曲面であるため混色性に優れ、色の均一性を向上させることができる。

【００６６】（比較例）同様に、比較例として導光板端面に図１９のように、導光板端面と第１の主面と第２の主面の３つの面と接するような円柱形状の切り欠き部が形成された導光板とした以外は実施例と同様にして面状発光装置を作製する。この比較例１の面発光装置において、ＬＥＤチップにＬＥＤに電流を流して面状に発光させたところ、ＬＥＤと導光板端面の第１の主面に形成された切り欠き部の間にできた隙間から光が漏れだし、その部分だけが極端に明るくなる異常発光が認められ、均一な面発光が得られなかった。又、その他の部分の発光輝度も充分ではなかった。

【００６７】

【発明の効果】以上詳細に説明したように、本発明の面発光装置は、ＬＥＤ素子から放出されて導光板に入射する光を均一、かつ高輝度に導光板から放出させることができ、しかも導光板の発光面における異常発光を防止できる。

【図面の簡単な説明】

【図１】 本発明に係る実施の形態１の面発光装置の平面図である。

【図２】 実施の形態１の導光板の斜視図である。

【図３】 実施の形態１のＬＥＤ光源の正面図である。

【図４】 本発明に係る実施の形態２の面発光装置の平面図である。

【図５】 実施の形態２のＬＥＤバー光源の正面図である。

【図６】 実施の形態２の導光板の斜視図である。

【図７】 本発明に係る変形例１の面発光装置の分解斜視図である。

【図８】 （ａ）は本発明の面発光装置における拡散部における屈折を説明するための模式横断面図であり、（ｂ）は本発明の面発光装置における拡散部における屈折を説明するための模式縦断面図である。

【図９】 本発明に係る変形例２の面発光装置の導光板の斜視図である。

【図１０】 本発明に係る変形例３の面発光装置の導光板の断面図である。

【図１１】 本発明に係る変形例４の面発光装置の導光板の斜視図である。

【図１２】 本発明に係る変形例５の面発光装置の導光板の斜視図である。

【図１３】　本発明に係る変形例６の面発光装置の導光板の斜視図である。

【図１４】　本発明に係る変形例６の面発光装置の図１３とは異なる構造の導光板の斜視図である。

【図１５】　本発明に係る変形例７の面発光装置の導光板の斜視図である。

【図１６】　本発明に係る変形例７の面発光装置の図１５とは異なる構造の導光板の斜視図である。

【図１７】　本実施の形態１に係る面発光装置の導光板１の発光面における発光状態を示す図である。

【図１８】　図１９に示す面発光装置（従来例）の導光板の発光面における発光状態を示す図である。

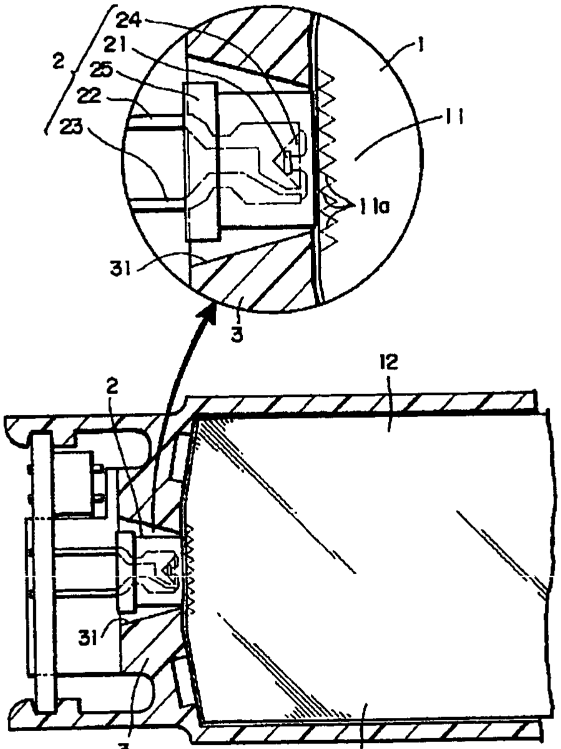
【図１９】　従来例の面発光装置の平面図である。

【図２０】　（ａ）は従来例の面発光装置における拡散部における屈折を説明するための模式横断面図であり、（ｂ）は従来例の面発光装置における拡散部における屈折を説明するための模式縦断面図である。

【符号の説明】

１，１０１，５０１…導光板、
＊２…ＬＥＤ光源、
３…支持体、
４，１０３…反射層、
１０，１０４，５０４…導光板の端面、
１１，１１１，２１１，３１１，４１１，５１１，６１１，６１２…光拡散部、
１１ａ，１０５，１１１ａ，２１１ａ，３１１ａ，４１１ａ，５１１ａ，６１１ａ…切り欠き、
１２…発光面、
２１…ＬＥＤチップ（ＬＥＤ素子）、
２２，２３ａ…リードフレーム、
２２ａ…カップ、
２４，２５，１２４…透光性樹脂、
２６，１２６…出射面、
１００…ＬＥＤバー光源、
１０２…発光部、
１２５…バー本体部、
１３１…凹部、
＊　５０５，５０５ａ…窪み。

【図１】



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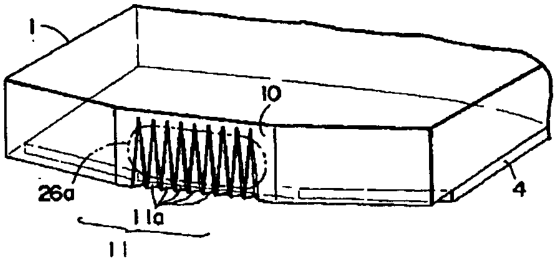

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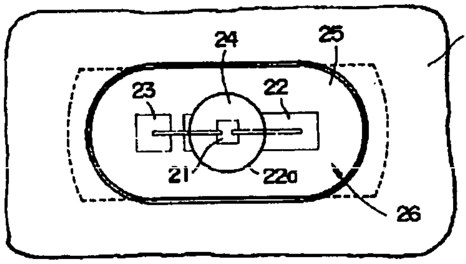

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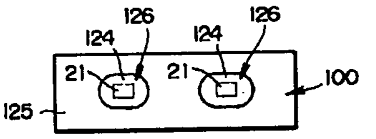

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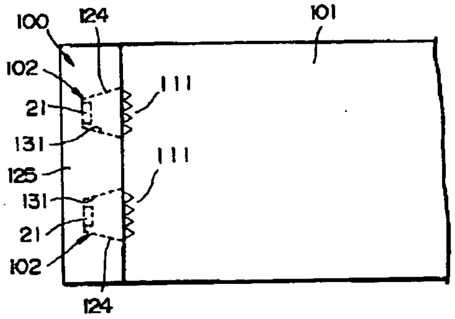

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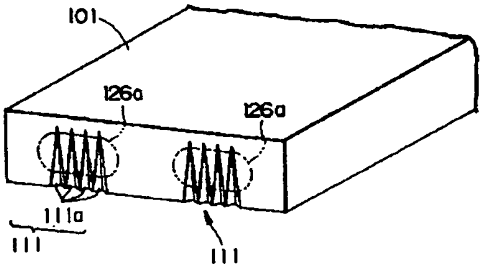

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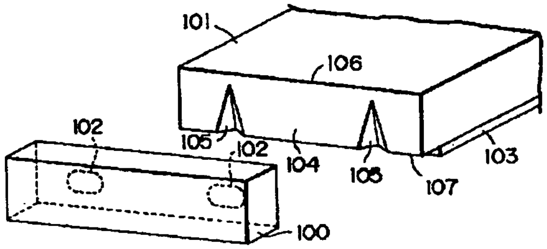

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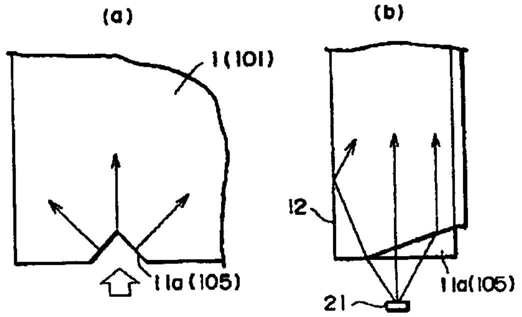

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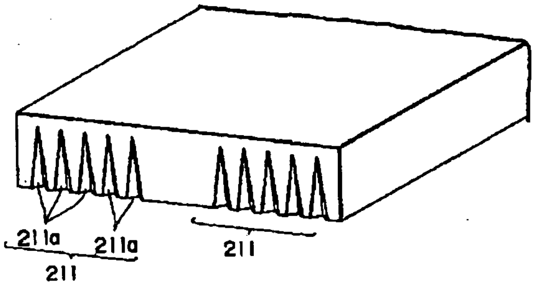

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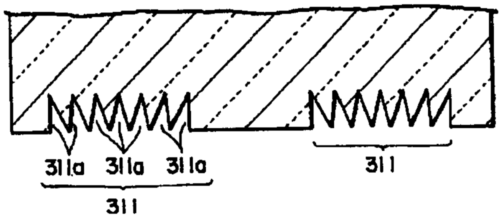

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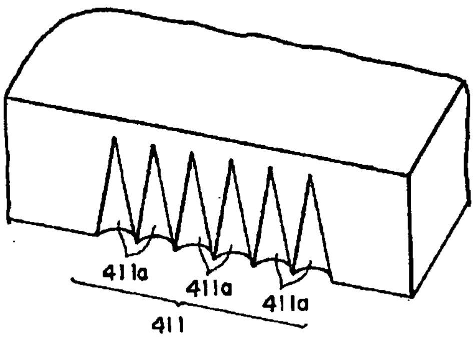

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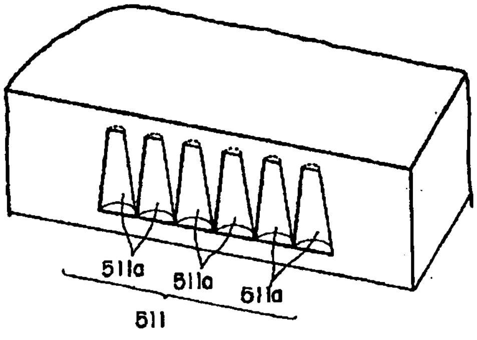

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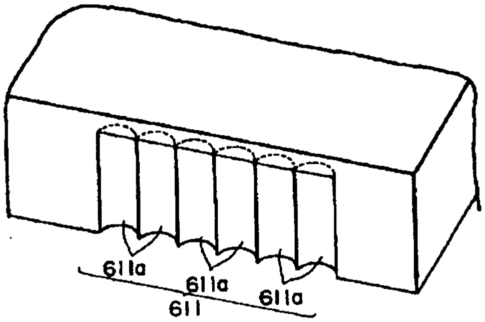

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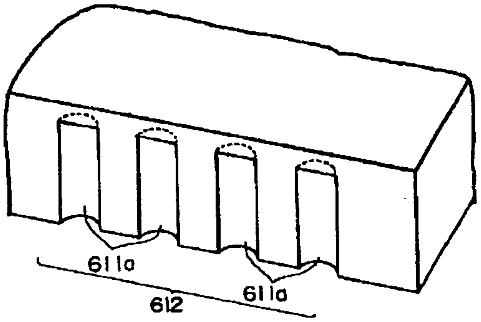

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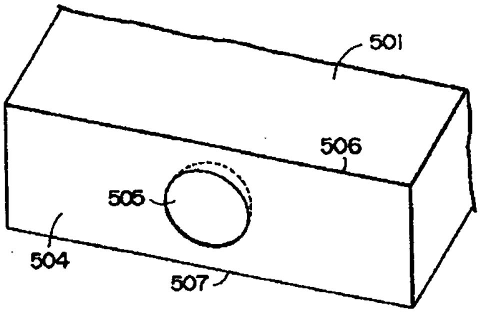

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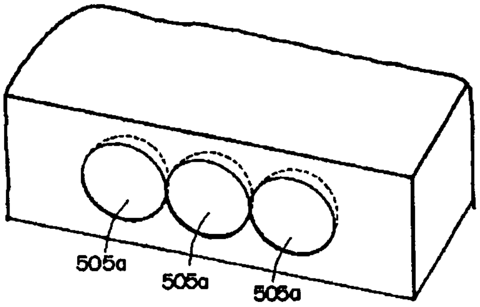

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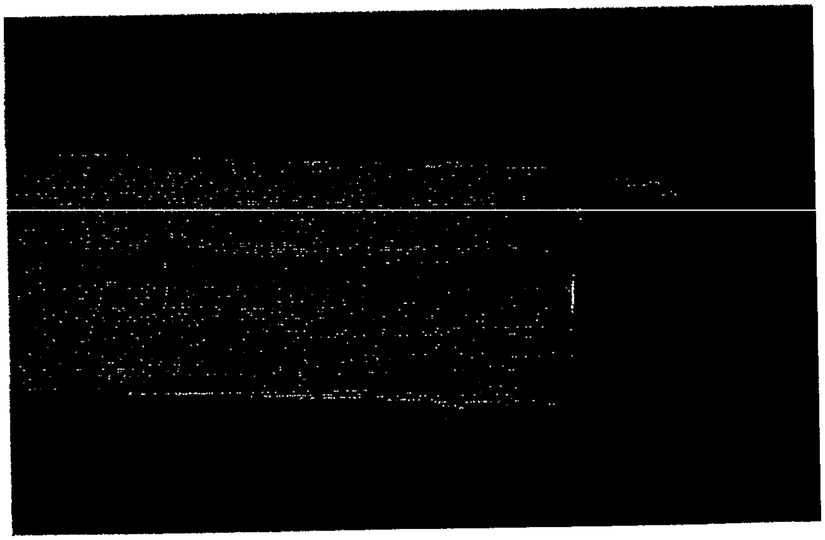

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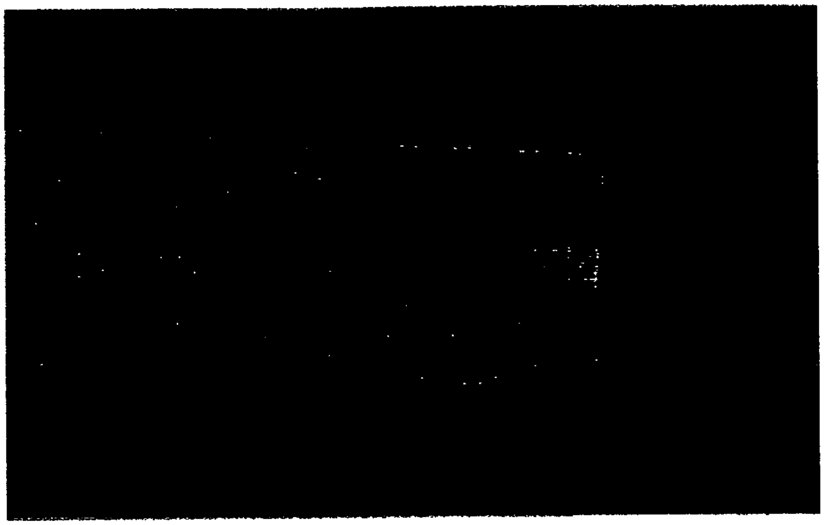
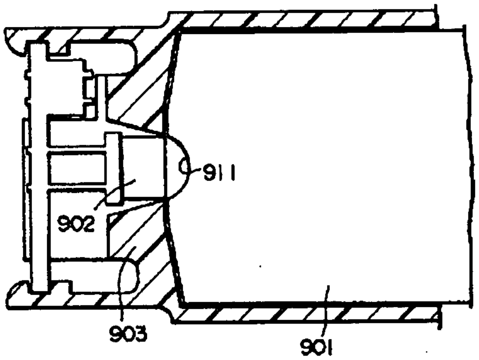
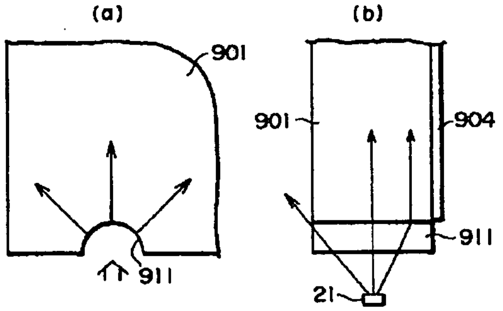


【図１９】



【図２０】



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(30)Priority

Priority number : 11130376 Priority date : 11.05.1999 Priority country : JP

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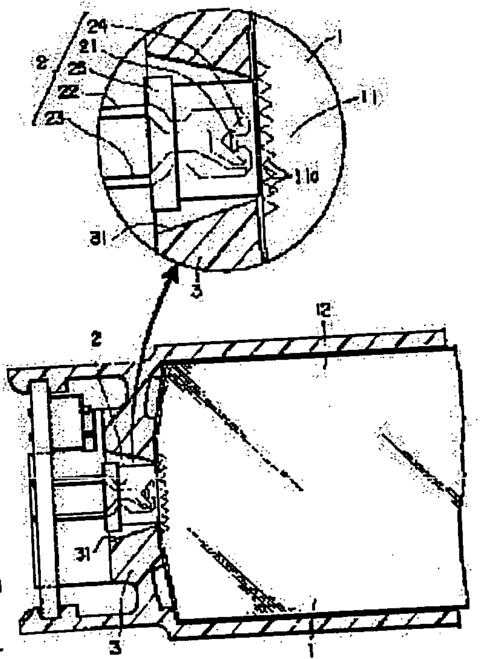
(54) SURFACE LUMINESCENT DEVICE



(57)Abstract:

PROBLEM TO BE SOLVED: To enhance uniformity and to provide high brightness luminescence by installing the upper end of a recessed light diffusion part for diffusing incoming light from an LED light source in a light guide plate on one end surface of the light guide plate, so that the upper end is apart from the upper surface at one end surface.

SOLUTION: This surface luminescent device has a light guide plate 1, so as to provide a reflecting layer on the bottom surface which is one surface of the opposite main surfaces and using the other surface as a luminescent surface 12, and LED light source 2 in which an outgoing surface faces an incoming end surface which is one end surface of the light guide plate 1, and a supporter 3 for holding the light guide plate 1 and the LED light source 2 in the prescribed position relation. In this device, a light diffusion part 11 having plural triangular prism-shaped notches 11a is formed in a part facing the outgoing surface of the LED light source 2 at the incoming surface of the light guide plate 1. Thereby, abnormal luminescence in the vicinity of the light diffusion part 11 on the luminescent surface 12 of the light guide plate 1 can be suppressed, and uniformity of in-plane distribution of luminescent intensity on the luminescent surface 12 can be improved.

LEGAL STATUS

[Date of request for examination] 14.07.2000

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[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

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[JP,2001-028203,A]

[Claim(s)]

[Claim 1]
It is field luminescence equipment the above-mentioned optical diffusion section carries out that separate and the upper limit of this optical diffusion section is formed from the above-mentioned upper surface in the above-mentioned end side as the feature by having the following and the above-mentioned light guide plate having the optical diffusion section which became depressed so that the light by which incidence was carried out to the above-mentioned end side from the above-mentioned Light Emitting Diode light source may distribute in the above-mentioned light guide plate in the field luminescence equipment which carries out the outgoing radiation of the light from the upper surface of the above-mentioned light guide plate. The light guide plate which has the upper surface which counters mutually, and an inferior surface of tongue. The reflector prepared in the inferior surface of tongue of this light guide plate. The Light Emitting Diode light source prepared so that incidence of the light from the Light Emitting Diode element of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. might be carried out for at least one Light Emitting Diode element from the end side of the above-mentioned light guide plate.

[Claim 2]
The above-mentioned optical diffusion section is field luminescence equipment according to claim 1 which is notching which cuts a half-size drill or in the shape of a semicircle drill toward the above-mentioned inferior surface of tongue by making into a vertex one point which is distant from the above-mentioned upper surface in the above-mentioned end side, and it comes to lack.

[Claim 3]
The above-mentioned notching is field luminescence equipment according to claim 2 which has a triangular pyramid configuration.

[Claim 4]
Field luminescence equipment according to claim 2 or 3 with which two or more above-mentioned notching is formed to the Light Emitting Diode element piece.

[Claim 5]
Field luminescence equipment according to claim 4 with which notching adjoined of two or more notching formed corresponding to the above-mentioned Light Emitting Diode element piece separated mutually, and was formed on the inferior surface of tongue of the above-mentioned light guide plate.

[Claim 6]
The inclined plane which the above-mentioned notching is a triangular pyramid configuration which has two inclined planes, respectively, and constitutes at least two notching in the above-mentioned notching is field luminescence equipment according to claim 4 or 5 currently formed in an angle which is different to the above-mentioned end side, respectively.

[Claim 7]
Each inclined plane which constitutes two or more above-mentioned notching is field luminescence equipment according to claim 6 currently formed in an angle which is mutually different to the above-mentioned end side, respectively.

[Claim 8]
The above-mentioned optical diffusion section is field luminescence equipment according to claim 1 with which the upper limit and soffit of this optical diffusion section separate from the above-mentioned upper surface and the above-mentioned inferior surface of tongue, and are formed in the above-mentioned end side, respectively.

[Claim 9]
The inside of the above-mentioned optical diffusion section is field luminescence equipment according to claim 8 which is a curved surface.

[Claim 10]
The inside of the above-mentioned optical diffusion section is field luminescence equipment according to claim 9 which is the spherical surface.

[Claim 11]
The above-mentioned optical diffusion section is field luminescence equipment according to claim 9 which is a semicircle pilaster-like.

[Claim 12]
The above-mentioned Light Emitting Diode element is field luminescence equipment of any one publication among the claims 1-11 covered by the translucency resin.

[Claim 13]
It is field luminescence equipment of any one publication among the claims 1-11 are the crevice where the above-mentioned field luminescence equipment was formed in the field by which opposite arrangement is carried out, and this field in the above-mentioned end side of the above-mentioned light guide plate, and carry out that the above-mentioned Light Emitting Diode element was prepared, and had the Light Emitting Diode bar light source which comes to have the light-emitting part with which it comes to fill up a translucency resin, and the above-mentioned optical diffusion section was prepared so that it may counter with the outgoing-radiation side of the above-mentioned

[Claim 14]
The above-mentioned Light Emitting Diode bar light source is field luminescence equipment according to claim 13 which has two or more light-emitting parts.

[Claim 15]
The above-mentioned translucency resin is field luminescence equipment of any one publication among the claims 12-14 which absorb the light which the above-mentioned Light Emitting Diode element generates, and contain the fluorescent substance which generates the light of the wavelength from which the wavelength of the absorbed light differs.

[Claim 16]
It is field luminescence equipment according to claim 15 which the above-mentioned Light Emitting Diode element is a light emitting device to which the light can emit light, and the above-mentioned fluorescent substance absorbs the light from the above-mentioned light emitting device, and is the fluorescent substance with which the light of long wavelength can emit light rather than the absorbed light.

[Claim 17]
The above-mentioned light-emitting part is field luminescence equipment according to claim 15 or 16 which outputs the white light by the color mixture of the light which the above-mentioned Light Emitting Diode element generates, and the light which the above-mentioned fluorescent substance generates from the above-mentioned outgoing radiation side.

[Claim 18]
It is field luminescence equipment according to claim 15 to 17 which is the yttrium aluminum garnet fluorescent substance by which the above-mentioned Light Emitting Diode element comes to have a nitride semiconductor, and the above-mentioned fluorescent substance was activated with the cerium.

[Detailed Description of the Invention]

[0001] [The technical field to which invention belongs]
As for this invention, it is possible to make the light by which incidence is carried out from the Light Emitting Diode chip which is the point light source emit light uniformly in respect of luminescence of a light guide plate, and it relates to the field luminescence equipment used for a liquid crystal back light, a panel meter, an annunciator, a field luminescence switch, etc.

[0002] [Description of the Prior Art]
In recent years, the field luminescence equipment which makes the light from the Light Emitting Diode chip which is the point light source emit light in the shape of a field as the light sources, such as a liquid crystal back light, is used. This field luminescence equipment is constituted so that incidence of the light from [from the end side of the light guide plate which has the principal plane which counters] 1 or 2 or more light emitting diodes may be carried out and outgoing radiation of the light may be carried out from one whole principal plane of the light guide plate. In this field luminescence equipment, it is important to output light to homogeneity from the outgoing radiation side, and in order to realize this homogeneity, various structures are proposed. An example of the field luminescence equipment of the proposed conventional example is typically shown in drawing 19 . Opposite arrangement is carried out at the end face of the light guide plate 901 which consists of a penetrable resin which it has [resin] the 1st principal plane and 2nd principal plane, and can make light penetrate, and its light guide plate 901, and the field luminescence equipment of drawing 19 has the reflector 904 in which light is reflected so that a Light Emitting Diode element may be prepared at a Light Emitting Diode mould section [which comes to carry out a mould to the interior] 902, and 2nd [of a light guide plate] principal plane side and may make light emit from a 1st principal plane

[0003] With the field luminescence equipment of this drawing 19 , by forming the semicircle pilaster-like notching 911 in the incidence end face of a light guide plate 901, it constitutes so that light may be uniformly distributed and inputted in the direction of a field parallel to the principal plane of a light guide plate 901, and the light inputted from the Light Emitting Diode element by this is attaining equalization of field-like luminescence outputted from the 1st principal plane.

[0004] [Problem(s) to be Solved by the Invention]
however — the field luminescence equipment of the conventional example of drawing 19 — the 1st principal plane of a light guide plate — setting — the near notching section 911 — ** — there was a trouble of becoming bright extremely Moreover, still, the field luminescence equipment of the conventional example of drawing 19 was not enough, although fixed equalization within a field was attained by the notching section 911.

[0005] Then, this invention solves the above-mentioned problem, and it excels in homogeneity more, and aims at offering the field-like luminescence equipment in which high brightness luminescence is possible.

[0006] [Means for Solving the Problem]
As a result of various experiment examination, by forming the optical diffusion section of a predetermined configuration in a light guide plate end face, this invention person finds out that the light which carries out incidence from a light guide plate edge can be uniformly diffused by the inside of a light guide plate, and came to accomplish this invention.

[0007] Namely, the light guide plate which has the upper surface where the field luminescence equipment of this invention counters mutually, and the undersurface, It has the reflector prepared in the undersurface of this light guide plate, and the Light Emitting Diode light source prepared so that incidence of the light from the Light Emitting Diode element of owner Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. might be carried out for at least one Light Emitting Diode element from the end side of the above-mentioned light guide plate. In the field luminescence equipment which carries out outgoing radiation of the light from the upper surface of the above-mentioned light guide plate the above-mentioned light guide plate to the above-mentioned end side It has the optical diffusion section which became depressed so that the light by which incidence was carried out from the above-mentioned Light Emitting Diode light source might be distributed in the above-mentioned light guide plate, and the above-mentioned optical diffusion section is characterized by for the upper limit of this optical diffusion section separating from the above-mentioned upper surface, and forming it in the above-mentioned end side. Thus, in the constituted field luminescence equipment, since it separates from the upper surface of a light guide plate and this upper limit is formed in the end side of the above-mentioned light guide plate so that opening may not be formed in the upper surface of a light guide plate, the above-mentioned optical diffusion section can prevent that direct light leaks from the upper surface of the above-mentioned light guide plate, and can carry out uniform field luminescence without unusual luminescence. Here, the thing of a field which makes the upper surface of a light guide plate emit light is said, and the undersurface means the field of the opposite side of a luminescence side.

[0008] Moreover, in the field luminescence equipment of this invention, as for the above-mentioned optical diffusion section, it is desirable that it is notching which cuts a half-size drill or in the shape of a semicircle drill toward the above-mentioned undersurface by making into a vertex one point which is distant from the above-mentioned upper surface in the above-mentioned end side, and it comes to lack in order to make the light by which incidence was carried out emit light on the upper surface of a light guide plate efficiently.

[0009] Moreover, as for the above-mentioned notching, in the field luminescence equipment of this invention, it is desirable that it is a triangular pyramid configuration.

[0010] Moreover, in the field luminescence equipment of this invention, in order to make the light by which incidence is carried out from the Light Emitting Diode light source emit light efficiently on the upper surface of a light guide plate, it is desirable that two or more above-mentioned notching is formed to a Light Emitting Diode element piece.

[0011] Moreover, in the field luminescence equipment of this invention, notching adjoined of two or more notching formed corresponding to the above-mentioned Light Emitting Diode element piece separates mutually on the undersurface of the above-mentioned light guide plate, and may be made to be formed. If it does in this way, since the light which can form a flat part with a comparatively large area between notching, and the light which carries out incidence for the light which carries out incidence by this closing, and lacking diffuses, and carries out incidence to a flat side will spread ahead, uniform field-like luminescence can be carried out in the field luminescence equipment of a comparatively long configuration.

[0012] Furthermore, in the field luminescence equipment of this invention, the above-mentioned notching is a triangular pyramid configuration which has two inclined planes, respectively, and, as for the inclined plane which constitutes at least two notching in the above-mentioned notching, it is desirable to be formed in an angle which is different to the above-mentioned end side, respectively so that the light from the Light Emitting Diode light source may diffuse more and incidence may be carried out to a light guide plate.

[0013] Moreover, in the field luminescence equipment of this invention, as for each inclined plane which constitutes two or more above-mentioned notching, it is desirable to be formed in an angle which is mutually different to the above-mentioned end side, respectively so that the light from the Light Emitting Diode light source may diffuse further and incidence may be carried out to a light guide plate.

[0014] Moreover, in the field luminescence equipment of this invention, in order to prevent that the light from the Light Emitting Diode light source leaks from the upper surface and the undersurface of a light guide plate, the upper limit and soffit of this optical diffusion section separate from the above-mentioned upper surface and the above-mentioned undersurface in the above-mentioned end side, respectively, and the above-mentioned optical diffusion section may be made to be formed.

[0015] Moreover, in the field luminescence equipment of this invention, the inside of the above-mentioned optical diffusion section may be a curved surface.

[0016] Furthermore, in the field luminescence equipment of this invention, the inside of the above-mentioned optical diffusion section may be the spherical surface.

[0017] Moreover, in the field luminescence equipment of this invention, ****** of the above-mentioned optical diffusion section is also good at the shape of a semicircle pilaster.

[0018] Furthermore, in the field luminescence equipment of this invention, the above-mentioned Light Emitting Diode element can also be covered by the translucency resin.

[0019] Moreover, the field luminescence equipment of this invention is the crevice formed in the field by which opposite arrangement is carried out, and this field in the above-mentioned end side of the above-mentioned light guide plate, and the above-mentioned Light Emitting Diode element was prepared, and it may have the Light Emitting Diode bar light source which comes to have the light-emitting part with which it comes to fill up a translucency resin, and in this case, the above-mentioned optical diffusion section is prepared so that it may counter with the outgoing radiation side of the above-mentioned light-emitting part.

[0020] Moreover, in the field luminescence equipment of this invention, the above-mentioned Light Emitting Diode bar light source may be equipped with two or more light-emitting parts.

[0021] which can be used as field luminescence equipment with brightness sufficient also by field luminescence of a large area by this Furthermore, in the field luminescence equipment of this invention, the above-mentioned translucency resin may contain the fluorescent substance which generates the light of wavelength which absorbs the light which the above-mentioned Light Emitting Diode element generates, and is different from the wavelength of the absorbed light.

[0022] Moreover, in the field luminescence equipment of this invention, the above-mentioned Light Emitting Diode element is made into the light emitting device to which the light can emit light, and the light from the above-mentioned light emitting device can be absorbed, and let the above-mentioned fluorescent substance be the fluorescent substance with which the light of long wavelength can emit light rather than the absorbed light. The luminescent color of arbitrary color tones can be made to check by looking with the various combination of a Light Emitting Diode element and a fluorescent substance in this composition.

[0023] Moreover, in the field luminescence equipment of this invention, the above-mentioned light-emitting part can be constituted so that the white light by the color mixture of the light which the above-mentioned Light Emitting Diode element generates, and the light which the above-mentioned fluorescent substance generates may be outputted from the above-mentioned outgoing radiation side.

[0024] [0025] which can be constituted so that the white light may be outputted from the above-mentioned outgoing radiation side by setting the above-mentioned Light Emitting Diode element to Light Emitting Diode which comes to have a nitride semiconductor in the above-mentioned field luminescence equipment, and using the above-mentioned fluorescent substance as the yttrium aluminum garnet fluorescent substance activated with the cerium

[Embodiments of the Invention]
The field luminescence equipment of this invention introduces into a light guide plate the light emitted from the Light Emitting Diode light source, and is made to emit light in the shape of a field. When the plate-like light guide plate of an abbreviation rectangle is used when **** luminescence equipment can choose the configuration of the light guide plate used according to the use and purpose, for example, it uses for the back light of liquid crystal, such as a personal computer, and using for the back light of the

panel meter of an automobile etc., the light guide plate of a configuration according to the design is used. Hereafter, the field luminescence equipment of the form of operation concerning this invention is explained, referring to a drawing.

[0026] The field luminescence equipment of the gestalt 1 of operation concerning the gestalt 1. this invention of operation The light guide plate 1 which makes the field of another side the luminescence side 12 for a reflecting layer 4 in preparation for the inferior surface of tongue which is one field of the principal plane which counters as shown in drawing 1 and drawing 2 , It consisted of a resin Plastic solid and has the Light Emitting Diode light source 2 arranged so that the outgoing radiation side may counter the incidence end face which is an end side of a light guide plate 1, and the base material 3 which holds a light guide plate 1 and the Light Emitting Diode light source 2 by the position relation. Especially here the field luminescence equipment of the gestalt 1 of this operation It is characterized by forming the optical diffusion section 11 which has notching 11a of two or more triangular pyramid configurations into the outgoing radiation side 26 of the Light Emitting Diode light source 2 in the incidence end face of a light guide plate 1, and the portion which counters. by this Unusual luminescence near the optical diffusion section 11 in the luminescence side 12 of a light guide plate 1 can be suppressed, and th homogeneity of the field interior division cloth of the luminescence intensity in the luminescence side 12 can be raised.

[0027] If it explains in detail, in the field luminescence equipment of the gestalt 1 of this operation, as the Light Emitting Diode light source 2 is shown in drawing 1 and drawing 3 , the Light Emitting Diode chip (Light Emitting Diode element) 21 will be formed in cup 22a formed in the point of a leadframe 22, and it will fill up with the translucency resin 24 containing a fluorescent substance in the cup, and will come to carry out the mould of the whole using the translucency resin 25. Here, the mould of the translucency resin 25 is carried out so that the outgoing radiation side 26 may become flat, as shown in drawing 3 . Moreover, one electrode of the electrodes of the positive/negative of the Light Emitting Diode chip 21 is connected to a leadframe 22, and the electrode of another side is connected to the leadframe 23 prepared in the leadframe 22 by approaching.

[0028] In the gestalt 1 of this operation, as it comes to fabricate a translucency resin by injection molding and a light guide plate 1 is shown in drawing 2 , notching 11a of two or more triangular pyramid configurations is formed in the end side 10, and the optical diffusion section 11 is constituted by two or more of the notching 11a. This notching 11a is formed in the shape of a triangular pyramid so that it may spread toward the inferior surface of tongue in which the reflecting layer 4 was formed by making into a vertex one point which is distant from the luminescence side 12 in the end face 10 of a light guide plate 1. In addition, the portions which attach the sign of 26a in drawing 2 , and are shown according to a two-dot chain line are the outgoing radiation side 26 of the Light Emitting Diode light source 2, and a portion made to counter in an end face 10.

[0029] Moreover, in the gestalt 1 of operation, the Light Emitting Diode light source 2 and a light guide plate 1 are positioned, and a base material 3 is fixed so that it may approach and the outgoing radiation side 26 of the Light Emitting Diode light source 2 and the optical diffusion section 11 of a light guide plate 1 may be made to counter as shown in drawing 1 . In addition, the element arrangement section 31 which arranges the Light Emitting Diode light source 2 in a base material 3 was formed so that the amount of the opening might become the same configuration substantially with the outgoing radiation side 26 of the Light Emitting Diode light source 2, and thereby, the light which leaked from portions other than outgoing radiation side 26 of the Light Emitting Diode light source 2 has prevented being inputted into a light guide plate 1 from portions other than optical diffusion section 11. That is, this element arrangement section 31 has restricted the optical path so that incidence of the light from the Light Emitting Diode light source 2 may be carried out to a light guide plate 1 only from the optical diffusion section 11 while arranging the Light Emitting Diode light source 2 to a position.

[0030] In the field luminescence equipment of the gestalt 1 of the operation constituted as mentioned above, since the optical diffusion section 11 of a light guide plate 1 is equipped with notching 11a of two or more triangular pyramid configurations and is constituted, it has the following operation effects. That is, since notching 11a of a triangular pyramid configuration has two fields (henceforth the 1st inclined plane and the 2nd inclined plane) which inclined to the end face 10, incidence of the light which carried out incidence to the 1st inclined plane and the 2nd inclined plane with th incident angle (angle of the travelling direction of light and the normal of a field to accomplish) smaller than a fixed angle (total reflection angle) is carried out into a light guide plate 1 with the angle of refraction according to the incident angle. At this time, th light to which incidence only of the part which inclines since the 1st inclined plane and the 2nd inclined plane incline inside to an end face 10, respectively was carried out from the 1st inclined plane and the 2nd inclined plane spreads in the dir ction of the side of a light guid plate 1, and incidence is carried out into a light guide plate 1. Moreover, total reflection of the light which carried out incidence to one 1st inclined plane or the 2nd inclined plane with the larger incident angle than a total reflection angle is carried out in the 1st inclined plane or the 2nd inclined plane, and incidence of the light by which total reflection was carried out is carried out into a light guide plate 1 from the 2nd inclined plane of another side, or the 1st inclined plane, respectively. Thus, as typically shown in drawing 8 (a), the light by which incidence was carried out to the optical diffusion section 11 is diffused, and incidence is carried out into a light guide plate 1, consequently it can raise the homogeneity of the luminescence brightness in the luminescence side 12 of a light guide plate 1.

[0031] Moreover, in the field luminescence equipment of the gestalt 1 of this operation, notching 11a is formed in the shape of a triangular pyramid toward the inferior surface of tongue in which the reflecting layer 4 was formed by making into a vertex one point which is distant from the luminescence side 12 in the end face 10 of a light guide plate 1. That is, since notching 11a does not have opening in the luminescence side 12, as shown in drawing 8 (b), it can prevent that outgoing radiation of the light by which outgoing radiation was carried out from the light emitting device 2 is directly carried out from a luminescence side. Thereby, unusual luminescence produced from the crevice (opening) made between the light guide plate and Light Emitting Diode by light's leaking and carrying out a direct-vision private seal that only the portion becomes extremely bright can be prevented like the conventional example.

[0032] moreover -- since notching 11a is formed in the shape of a triangular pyramid so that it may spread toward an inferior surface of tongue -- the -- the 1 2nd inclined plane is suitable caudad, and is formed, and the light which carried out incidence perpendicularly to the end face of a light guide plate 1 can be made refracted in the direction of an inferior surface of tongue Since it can be made to be able to reflect up by the reflecting layer 4 in which the light which carried out incidence perpendicularly to the end face 10 of a light guide plate 1 was prepared by this on the inferior surface of tongue of a light guide plate and can output from the luminescence side 12, it can output more effectively from a luminescence side. That is, although the light which carried out incidence perpendicularly to the end face 10 of a light guide plate 1 is light with comparatively high intensity, the rate which is not effectively used as a light to which the light by which incidence was perpendicularly carried out to it being structure like the conventional example to the end face advances the inside of a light guide plate in parallel to a luminescence side, is outputted from an other-end side, and is outputted from a luminescence side becomes high. on the other hand, the gestalt 1 of this operation -- like -- the -- if the 1 2nd inclin d plane is suitable caudad and is formed, the light which carried out incidence perpendicularly to the end face 10 of a light guide plate 1 can be made refracted towards the reflecting layer 4 in which it was prepared on the inferior surface of tongue of a light guide plate, incidence can be carried out, and the light reflected by the reflecting layer 4 can be outputted from a luminescence side

[0033] As mentioned above, as shown in drawing 17 , the field luminescence equipment of the g stalt 1 of this operation does not have unusual luminescence that a part of luminescence side 12 becomes extremely bright, and can observe uniform luminescenc in a luminescence side. Moreover, sinc incidence can be carried out into a light guide plate 1, without leaking the light from the Light Emitting Diode light source outside, light can be used efficiently and th luminescence brightness of the whole field can be made high. In addition, drawing 18 is drawing showing the situation of luminescence in th luminescence side at th time of using the light guide plate of the conventional example. In this drawing 18 , remarkable unusual lumin scence is observed [near the optical diffusion section of a light guid plate].

[0034] Gestalt 2. of operation, next the field luminescence equipment of the gestalt 2 of operation concerning this invention are explained. The field luminescence equipment of the gestalt 2 of this operation is equipped with the Light Emitting Diode bar light source 100 and the light guide plate 101 as shown in drawing 4 . In the gestalt 2 of operation, the Light Emitting Diode bar light source 100 has two or more light-emitting parts 102, as shown in drawing 4 and drawing 5 , and the Light Emitting Diode chip 21 is formed in the crevice 131 formed in the side of the bar book soma 125 which consists of a resin Plastic solid, and, as for the light-emitting part 102, it comes to fill up the translucency resin 124. Here, the translucency resin 124 outputs the light of a desired color from the outgoing radiation side 126 including the fluorescent substance which generates the light of wavelength which absorbs the light which the Light Emitting Diode chip 21 generates, and is different from the wavelength of the absorbed light by the color mixture of the light and the light from a fluorescent substance which the Light Emitting Diode chip 21 generates.

[0035] Moreover, in the field luminescence equipment of the gestalt 2 of operation, it comes to fabricat a translucency resin by injection molding, and, as for a light guide plate 101, opposite arrangement of the end side is carried out at the side in which two or more light-emitting parts 102 of the Light Emitting Diode bar light source 100 were formed. And as shown in drawing 6 , notching 111a of two or more triangular pyramid configurations is formed in a light-emitting part 102 and the portion which counters, and the two optical diffusion sections 111 which consist of two or more notching 111a, respectively are formed in the end side of the light guide plate 101. In addition, the portions which attach the sign of 126a in drawing 6 , and are shown according to a two-dot chain line are the outgoing radiation side 126 of a light-emitting part 102, and a portion made to counter. Here, notching 111a in the gestalt 2 of this operation is formed in the shape of a triangular pyramid toward the inferior surface of tongue in which a reflecting layer is prepared by making into a vertex one point which is distant from the upper surface which is a luminescence side in the end side of a light guide plate 101 like the gestalt 1 of operation.

[0036] Since the field luminescence equipment of the gestalt 2 of the operation constituted as mentioned above had the same operation effect as the gestalt 1 of operation and is equipped with two or more light-emitting parts 102, it can constitute field luminescence equipment with a more large luminescence area. In addition, although two light-emitting parts 102 are shown in drawing 4 etc., this invention is not restricted to this and the Light Emitting Diode bar light source may have two or mor light-emitting parts.

[0037] The modification concerning this invention is explained below a <modification>. The field luminescence equipment of the modification 1 concerning a modification 1. this invention is constituted like the field luminescence equipment of the gestalt 2 of operation in the light guide plate 101 of the field luminescence equipment of the gestalt 2 of operation except having replaced with two or more notching 111a, and the notching 105 of one triangular pyramid configuration having constituted the optical diffusion section, as shown in drawing 7 . In addition, the notching 105 of the triangular pyramid configuration in the field luminescence equipment of this modification 1 is greatly formed as compared with the notching 11a and 111a of the gestalt 1 of operation, and the gestalt 2 of operation. Moreover, in the field luminescence equipment of this modification 1, notching 105 is formed in th shape of a triangular pyramid toward the inferior surface of tongue in which the reflecting layer 4 was formed by making into a vertex one point which is distant from a luminescence side in the end face of a light guide plate 101.

[0038] Since the field luminescence equipment of the modification 1 constituted as mentioned above has two fields where notching 105 inclined to the end face 10, as the gestalt 1 of operation explained, incidence of the light by which incidence was carried out from two inclined planes is carried out into a light guide plate 1 so that it may be spread in the direction of the side of a light guide plate 101 (drawing 8 (a)). Therefore, even if it uses the light guide plate 101 equipped with one notching 105, the homogeneity of the luminescence brightness in the luminescence side of a light guide plate 101 can be raised.

[0039] Moreover, since notching 105 does not have opening in the luminescence side 12, as shown in drawing 8 (b), it can prevent that outgoing radiation of the light by which outgoing radiation was carried out from the light-emitting part 102 is directly carried out from the luminescence side 12. Thereby, unusual luminescence produced from the crevice (opening) made between the light guide plate and Light Emitting Diode by light's leaking and carrying out a direct-vision private seal that only the portion becomes extremely bright can be prevented like the conventional example.

[0040] Moreover, since notching 105 is formed in the shape of a triangular pyramid so that it may spread toward an inferior surface of tongue, the two inclined planes are suitable caudad, and are formed, and it can make the light which carried out incidence perpendicularly to the end face 104 of a light guide plate 101 refracted toward an inferior surface of tongue. Since it can be made to be able to reflect up by the reflecting layer 103 in which the light which carried out incidence perpendicularly to the end face 104 of a light guide plate 101 was prepared by this on the inferior surface of tongue of a light guide plate and can output from a luminescence side, it can output more effectively from a luminescence side.

[0041] Although the field luminescence equipment of the modification 1 concerning this invention has the same operation effect as the forms 1 and 2 of operation as explained above, the operation effects differ in the following points.
(1) In the field luminescence equipment of a modification 1, since the number of the notching 105 of a light guide plate 101 is one, structure of the metal mold for producing a light guide plate 101 can be simplified, and metal mold can be made cheap. Thereby, a light guide plate 101 can be made cheap.
(2) In the field luminescence equipment of a modification 1, since the number of the notching 105 of a light guide plate 101 is one, it is necessary to form notching 105 greatly inevitably as compared with the notching 11a and 111a of the forms 1 and 2 of operation. Thereby, the amount of the light which leaks under the light guide plate 101 through the space by notching 105 becomes large. therefore, the structure which constitutes two or more notching shell light diffusion sections of the forms 1 and 2 of operation is excellent in the viewpoint of making the light from the light source emit light from a luminescence side effectively

[0042] (3) Moreover, notching of a triangular pyramid configuration may carry out the spectrum of the light which functions as prism and is inputted from the light source to blue and yellow. In this case, with the forms 1 and 2 of the operation from which the incidence section was constituted by two or more notching, an optical phenomenon can be substantially abolished at this rate by being mixed with the light into which the spectrum of the light which the spectrum was carried out [the light] by a certain notching and was inputted was carried out, and it was inputted from other notching. Therefore, the structure of the forms 1 and 2 of the operation which constituted the optical diffusion section is excellent in the use from which an optical phenomenon poses a problem at this rate by forming two or more notching. Moreover, although the diffusion effect is determined by the configuration of notching, if two or more notching is formed about a Light Emitting Diode piece, in order to heighten the diffusion effect, a number can be set up so that a number can be changed and the diffusion effect of light may become higher.

[0043] Although the adjacent notching 11a and 111a formed with the forms 1 and 2 of modification 2. operation so that it might touch on the undersurface of a light guide plate 1,101, this invention is not restricted to this, and as shown in drawing 9 , adjoining notching leaves it mutually on the undersurface, and it may be formed. Thus, it can also design so that light may be most efficiently diffused in the optical whole diffusion section including the area and the configuration of a flat side where it is located between adjoining notching and it may input in a light guide plate . For example, if ****** with wide width of face is prepared among notching section 211a as compared with the forms 1 and 2 of operation, while the light by which incidence is carried out to notching 211a can be diffused and being able to make the corner by the side of an optical incidence end face spread light as shown in drawing 9 Since the light which carries out incidence to ****** can be made to spread towards an optical incidence end face and the end face of an opposite side, the fall of the brightness of a portion which is separated from Light Emitting Diode can be suppressed. Therefore, especially in the case where an optical incidence end face is a shorter side, and the configuration of a light guide plate is a slender configuration from which the side of an optical incidence end face serves as a long side, the composition of this modification 2 is effective and can lessen that the brightness of a side far from the Light Emitting Diode light source falls.

[0044] When notching of modification 3. plurality constitutes optical plan of incidence, the configurations of notching may differ mutually. For example, you may change the angle of the side attachment wall of notching as are shown in drawing 10 and it keeps away from the Light Emitting Diode element (chip) of the light source, when preparing two or more notching sections of the triangular pyramid configuration which consists of two flat surfaces. In the example shown in drawing 10 , the angle of the outside side attachment wall of notching 311a and a light guide plate end face to accomplish approaches right-angled, and the angle of an inside side attachment wall and a light guide plate end face to accomplish is changing conversely so that it may become small as notching section 311a which counters the transverse plane of a Light Emitting Diode element and which is located in the center section of the optical diffusion section is formed at the almost same angle to a light guide plate end face and it keeps away from a center section. If it does in this way, since light can be diffused more widely, even the corner of an incidence end face can be made to spread light. Therefore, it is effective when using a light guide plate with comparatively wide width of face. Although the example from which it was made for the angle of a side attachment wall to change was shown one by one in the above modification 3 as it separated from notching 311a located in the center in the optical diffusion section 311, this invention is not restricted to this and may change an angle at random. moreover, in drawing 10 , th angles to the end face of all the inclined planes of two or more notching 311a which constitutes the optical diffusion section 311 differ mutually -- as -- having formed (it forming so that two angles of the inclined plane of notching 311a chosen arbitrarily may differ mutually) -- this modification 3 is not restricted to this That is, if it constitutes from this invention so that the angles to the end face of the inclined plane of at least two notching in two or more notching 311a may differ, the same effect as this modification 3 will be acquired.

[0045] Although notching of a triangular pyramid configuration was formed, this invention is not restricted to a triangular pyramid configuration, and you may make it form the optical diffusion section 411 using notching 411a of a semicircle drill configuration with the field luminescence equipment of the forms 1 and 2 of modification 4. operation, as shown in drawing 11 . Even if it makes it above, it has the same operation effect as the forms 1 and 2 of operation. However, since the effective-area product by notching [in / the undersurface of a light guide plate / as compared with triangular pyramid-like notching / in notching 411a of a semicircle drill configuration] becomes large a little, the leakage of th light from the portion becomes large a little.

[0046] You may make it form the optical diffusion section 511 with modification 5. and the field luminescence equipment of this invention, using notching 511a of a semicircle frustum configuration, as shown in drawing 12 . Even if it makes it above, it has the same operation effect as the forms 1 and 2 of operation. Moreover, in the modification 5, the undersurface also separates from the undersurface of a light guide plate, and notching 511a of a semicircle frustum configuration is formed while the upper surface separates from the upper surface (luminescence side) of a light guide plate and is formed. Thus, it can prevent the leakage of the light from the undersurface of a light guide plate while it can prevent unusual luminescence in the luminescence side of a light guide plate, since formed notching 511a does not have a part for opening on the upper surface (luminescence side) and the undersurface of a light guide plate.

[0047] You may make it form the optical diffusion section 611 with modification 6. and the field luminescence equipment of this invention, using semicircle pilaster-like notching 611a, as shown in drawing 13 . here -- notching 611a -- the luminescence side of a light guide plate, and abbreviation -- it has an parallel upper-limit side and opening is carried out only on the undersurface of a light guide plate In addition, although notching 611a was formed in this modification 6 so that it might touch mutually, you may make it this invention form the optical diffusion section 612 by vacating and forming an interval mutually, as shown not only in this but in drawing 14 . Even if it makes it above, it has the same operation effect as the forms 1 and 2 of operation.

[0048] Although notching 11a and 111a was formed, you may make it this invention form the semi-sphere-lik hollow 505 in the end face 504 of a light guide plate 501 with the forms 1 and 2 of operation more than modification 7., as shown not only in this but in drawing 15 . in addition -- this modification 7 -- a hollow 505 -- both the upper limit and a soffit -- although -- the upper-limit side 506 of an end face 504 -- and it forms so that it may be cut soffit side 507 and **** detached building ****** may be carried out If it does in this way, since the light from the Light Emitting Diode light source does not leak from the luminescence side (upper surface) of a light guide plate directly, it can prevent unusual luminescence in a luminescence side. Moreover, in this modification 7, since light does not leak from the undersurface of a light guide plate directly, an incident light is efficiently emitted from a luminescence side within a light guide plate. Moreover, you may make it form two or more hollow 505a of a semi-sphere configuration in this modification 7, as shown in drawing 16 .

[0049] As the forms 1 and 2 and modifications 1-7 of operation explained in detail above, the field luminescence equipment of this invention It makes to form so that 1, the two or more notching sections, or a hollow may be formed in a light guide plate end face and the upper limit of the notching or a hollow may separate from a luminescence side at least into the minimum requirements. While diffusing the light by which incidence is carried out by this in a light guide plate and inputting it, unusual luminescence in a luminescence side is prevented. In addition, in this specification, notching and a hollow are named generically and it is called the optical diffusion section. Namely, by setting to this invention, notching or a hollow can be made into various configurations, such as the shape of a cone, the shape of a prism, and a configuration that cut off the peak section of a cone on the flat surface or the curved surface, as long as it has the minimum above-mentioned requirements. Here, the shape of a cone is a configuration which consists of the curved surface or flat surface built by connecting a base, and a periphery and a fixed point (vertex) at the bottom like a cone and a pyramid, and the vertex may be on the end face of a light guide plate, and may be located on the inside or the outside of a light guide plate end face. Moreover, the shape of a prism is a configuration surrounded like a pillar or a prism by the parallel bus-bar stood from the base.

[0050] The field luminescence equipment concerning this invention can be constituted so that the most suitable configuration may be chosen according to the configuration of a light guide plate and an incident light may be more effectively diffused out of the optical diffusion section of various configurations as mentioned above. in this case -- if the number of the optical diffusion sections is increased and the number of fields is made to increase, although it can reflect light more intricately and the homogeneity of brightness can be raised -- metal mold -- structure may become complicated and the problem of th configuration of the end face of the light guide plate produced by the metal mold as a result stopping being fixed etc. may also be produced Therefore, it is desirable to choose the configuration which also takes manufacture conditions into consideration in addition to the requirement specification by the purpose of use, and is used.

[0051] That is, in this invention, since various configurations can be chosen, the restrictions on manufacture of a target performance and metal mold (manufacture precision, manufacture cost, etc.), forming precision, etc. can be examined synthetically, and any shall be chosen between notching and a hollow as the optical diffusion section can determine them.

[0052] Hereafter, a desirable material about each element in the field luminescence equipment concerning this invention etc. is explained.

(Light guide plate)
It is desirable to use the thing excellent in light-transmission nature and the moldability as a material used for a light guide plate in this invention, and acrylic resin, polycarbonate resin, amorphous polyolefin

resin, polystyrene resin, etc. are mentioned. Although refractive indexes differ, since the material for these light guide plates can control diffusion of light the configuration of notching formed in a light guide plate end face, or a hollow, and by selecting the number etc. further, respectively, it can be equivalent to the material of any refractive indexes.

[0053] (Light Emitting Diode light source)
In the Light Emitting Diode light source of this invention, 1 or two or more Light Emitting Diode chips can be used. Moreover, it may b made to carry out incidence of the light from a Light Emitting Diode chip to a direct light guide plate, and the light which absorbs the light from the Light Emitting Diode chip for which light can be emitted and Light Emitting Diode chip of the light, for example, and is outputted from a Light Emitting Diode chip combining the fluorescent substance with which the light of long wavelength can emit light rather than it may be made to carry out incidence of the light from which wavelength differs into a light guide plate. That is, in this invention, it is possible by using a Light Emitting Diode chip combining a fluorescent substance to make the mixed color of various color tones emit light with the combination of a light emitting device and a fluorescent substance. It is hereafter used for the back light of liquid crystal etc. best, and it comes to have white luminescence Light Emitting Diode ****** with high need, and a nitride semiconductor, and the Light Emitting Diode chip in which blue luminescence is possible, and the example using the yttrium aluminum garnet fluorescent substance by which it was activated with the cerium are explained.

[0054] (Light Emitting Diode chip)
As a nitride system compound semiconductor (a general formula IniGajAlkN however 0<=i, 0<=j, 0<=k, i+j+k=1) which can be used here, there are various things including GaN by which InGaN and various impurities were doped. This Light Emitting Diode chip is formed by growing up semiconductors, such as InGaN and GaN, as a luminous layer on a substrate by the MOCVD method etc. As structure of a semiconductor, the thing of gay structure with MIS junction, PI junction, a PN junction, etc., hetero structure, or double hetero structure is mentioned. This nitride semiconductor layer can choose various luminescence wavelength with the material and its degree of mixed crystal. Moreover, it can also consider as the single quantum well structure and abundant child well structure which formed the semiconductor barrier layer by the thin film which the quantum effect produces. In this invention, it is desirable to use the Light Emitting Diode chip which can excite efficiently the yttrium aluminum garnet system fluorescent substance activated with the cerium which has and mentions later the semiconductor luminous layer for which light can be emitted blue as a Light Emitting Diode chip.

[0055] (Fluorescent substance)
There is a photoluminescence fluorescent substance which is excited by the light or ultraviolet rays and emits light as an example of the fluorescent substance used for the field luminescence equipment of this invention. Although the yttrium aluminum garnet system fluorescent substance activated with the cerium as a concrete example of a photoluminescence fluorescent substance as a fluorescent substance with which a white system can emit light by the complementary color with the light from the nitride semiconductor Light Emitting Diode chip with which a blue system can emit light is mentioned, the fluorescent substance which mixed two or more fluorescent substances and these fluorescent substances, such as Mg5Li6Sb6O13:Mn and Mg2TiO4:Mn, can also be used. Here, the yttrium aluminum garnet system fluorescent substance activated with the cerium as a more suitable fluorescent substance is shown below.

[0056] Especially the yttrium aluminum garnet system fluorescent substance activated with the cerium in this invention is used for the meaning containing the fluorescent substance which emits the fluorescence operation which shall interpret in a wide sense, and replaces a part or the whole of an yttrium by at least one element chosen from the group which consists of Lu, Sc, La, Gd, and Sm, or replaces a part or the whole of aluminum by both Ga, and both [either or].

[0057] In detail Furthermore, general formula (YzGd1-z) 3aluminum5O12:Ce The photoluminescence fluorescent substance shown by (0< z<=1 [however,]), and general formula (Re1-aSma) 3Re'5O12:Ce (however, 0<=a<1 and Re) it is chosen from Y, Gd, La, and Sc -- a kind and Re' at least are chosen from aluminum, Ga, and In -- it is a kind at least It is the photoluminescence fluorescent substance shown.

[0058]

[Example]

(Example 1)

The field-like luminescence equipment of the example 1 of this invention is an example using the light guide plate shown in drawing 6 used with the gestalt 2 of operation. Two places are formed in that with which eight notching section 111a of the shape of a pyramis to which the metal mold for light guide plate formation is from two flat surfaces on a 2nd [of a light guide plate end face] principal plane (inferior surface of tongue) side was located in a line, using a polycarbonate as a material of this light guide plate. Moreover, the metal mold is produced so that concavo-convex (crimp) processing for raising the homogeneity of the light which emits light to the 2nd principal plane of a light guide plate may be given. The injection molding of injection-pressure 1000 kgf/cm2 and the die temperature is carried out at 100 degrees C, setting molding temperature as 280 degrees C first, and fabrication of a light guide plate carrying out melting of the polycarbonate. And after cooling for 45 seconds, it takes out from metal mold. Thus, the light guide plate was formed. In this way, except for the end face which introduces light into the 1st principal plane (luminescence side) and light guide plate which take out light from a light guide plate in the shape of a field, a reflective sheet is installed in the obtained light guide plate. Moreover, the Light Emitting Diode light source with two Light Emitting Diode chips which become th end face of the light guide plate with which a reflective sheet is not prepared from the nitride semiconductor for which light can be emitted white is arranged. In this way, if current is passed for the Light Emitting Diode chip of the obtained field luminescence equipment, incidence of the light is carried out from the end face of a light guide plate, and it can make light emit in the shape of a field from the 1st principal plane of a light guide plate. Unusual luminescence with a part extremely bright [the formed field-like luminescence equipment] is not accepted, but luminescence brightness can also raise it.

[0059] (Example 2)

Acrylic resin was used as a material of a light guide plate, and 250 degrees C, injection-pressure 1100 kgf/cm2, 80 degrees C of die temperatures, and the cooldown delay were cast for molding temperature as about 30 seconds using metal mold with which three spherical hollows as shown in a light guide plate end face at drawing 16 are formed in two places like an example 1. The field-like luminescence equipment of the example 2 of this invention is formed like an example 1 except having mentioned above. Thus, in the obtained field-like luminescence equipment, if current is made to pass and shap [of a field]-emit light for a Light Emitting Diode chip, unusual luminescence with an extremely bright part is not accepted, but luminescence brightness can also raise it. Moreover, the field luminescence equipment of an example 2 can also do color nonuniformity with what was excellent in homogeneity few.

[0060] (Example 3)

Acrylic resin is used as a material of a light guide plate, and the molding temperature of 250 degrees C, injection-pressure 1100 kgf/cm2, 80 degrees C of die temperatures, and a cooldown delay are cast as about 30 seconds using metal mold with which the light guide plate which between adjoining notching shown in a light guide plate end face at drawing 9 left also on the inferior surface of tongue of a light guide plate is formed. The field-like luminescence equipment of the example 3 of this invention is formed like an example 1 except ****. In the field luminescence equipment of this example 3, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, the brightness of the portion which is separated from an optical incidence end face can also be raised by unusual luminescenc with an extremely bright part not having been accepted, and having established the flat side.

[0061] (Example 4)

Acrylic resin is used as a material of a light guid plate, and that with which the nine pyramis-like notching sections to which the angl of the field of notching was changed were located in a line as it kept away from Light Emitting Diode as shown in a light guide plate end face at drawing 10 casts 250 degre s C, injection-pressure 1100 kgf/cm2, 80 d gre s C of die temperatures, and a cooldown delay for molding temperature as about 30 seconds using metal mold which is formed in two places like an example 1. The field-like luminescence equipment of an example 4 is formed like an example 1 except ****. In the field luminescence equipment of this example 3, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, unusual luminescence with an extremely bright part is not accepted, but brightness can also raise it. It is brighter than an example 1 in the corner by the side of an optical incidence end face, and it can obtain more uniform field-like luminescence.

[0062] (Example 5)
Acrylic resin is used as a material of a light guide plate, and that with which six notching of the shape of a pillar as shown in a light guide plate end face at drawing 13 was located in a line casts 300 degrees C, injection-pressure 1500 kgf/cm2, 120 degrees C of die temperatures, and a cooldown delay for molding temperature as about 1 minute using metal mold which is formed in two places like an example 1. The field-like luminescence equipment of the example 5 of this invention is formed like an example 1 except ****. In the field luminescence equipment of this example 5, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, although some brightness nonuniformity will be accepted, since the side of the notching section is a curved surface, color mixture nature can be good and can raise the homogeneity of a color.

[0063] (Example 6)
Acrylic resin is used as a material of a light guide plate, and what was located in a line four pieces along with the longitudinal direction of a light guide plate while the fluorescent substance end face pinched the flat part of the notching section of the shape of a pillar like drawing 14 in between casts 300 degrees C, injection-pressure 1500 kgf/cm2, 120 degrees C of die temperatures, and a cooldown delay for molding temperature as about 1 minute using metal mold which is formed in two places like an example 1. Th field-like luminescence equipment of the example 6 of this invention is formed like an example 1 except ****. In the field luminescence equipment of this example 6, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, although some brightness nonuniformity will be accepted, since the side of the notching section is a curved surface, color mixture nature can be good and can raise the homogeneity of a color. Moreover, the brightness of the portion which is separated from an incidence end face can also be raised by preparing a flat part.

[0064] (Example 7)
Acrylic resin is used as a material of a light guide plate, and that to which the six notching sections of the shape of a cone like drawing 11 were located in a line with the light guide plate end face casts 220 degrees C, injection-pressure 600 kgf/cm2, 50 degrees C of die temperatures, and a cooldown d lay for molding temperature as about 30 seconds using metal mold which is formed in two places like an example 1. Except ****, it carries out like an example 1 and the field-like luminescence equipment of the example 7 of this invention is formed. In the field luminescence equipment of this example 7, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, since the side of the notching section is a curved surface, color mixture nature is good, the homogeneity of a color can be raised and brightness nonuniformity is superior to the thing of the prism-like notching section.

[0065] (Example 8)
Acrylic resin is used as a material of a light guide plate, and that with which six hollows of a configuration which cut off the cone-point portion as shown in a light guide plate end face at drawing 12 were located in a line casts 250 degrees C, injection-pressure 1200 kgf/cm2, 80 degrees C of die temperatures, and a cooldown delay for molding temperature as about 30 seconds using metal mold which is formed in two places like an example 1. The field-like luminescence equipment of the example 8 of this invention is formed like an example 1 except ****. In the field luminescence equipment of this example 3, if current is made to pass and shape[of a field]-emit light for a Light Emitting Diode chip, brightness nonuniformity can be superior to a ****-like thing, and since the side of the notching section is a curved surface, it can be excellent in color mixture nature, and can raise the homogeneity of a color.

[0066] (Example of comparison)
Field-like luminescence equipment is produced like an example except having considered as the light guide plate with which the notching section of the shape of a cylindrical shape which touches a light guide plate end face, the 1st principal plane, and three fields of the 2nd principal plane was similarly formed in the light guide plate end face like drawing 19 as an example of comparison. In the field luminescence equipment of this example 1 of comparison, when current was passed for the Light Emitting Diode chip at Light Emitting Diode and light was made to emit in the shape of a field, unusual luminescence to which light leaks from the crevice made between Light Emitting Diode and the notching section formed in the 1st principal plane of a light guide plate end face, and only a broth and its portion become extremely bright was accepted, and uniform field luminescence was not obtained. Moreover, th luminescence brightness of other portions was not enough, either.

[0067]
[Effect of the Invention]
As explained to the detail above, the field luminescence equipment of this invention can make the light which it is emitted from a Light Emitting Diode element, and carries out incidence to a light guide plate emit to homogeneity and high brightness from a light guide plate, and, moreover, can prevent unusual luminescence in the luminescence side of a light guide plate.

[Brief Description of the Drawings]

[Drawing 1]
It is the plan of the field luminescence equipment of the gestalt 1 of operation concerning this invention.

[Drawing 2]
It is the perspective diagram of the light guide plate of the gestalt 1 of operation.

[Drawing 3]
It is the front view of the Light Emitting Diode light source of the gestalt 1 of operation.

[Drawing 4]
It is the plan of the field luminescence equipment of the gestalt 2 of operation concerning this invention.

[Drawing 5]
It is the front view of the Light Emitting Diode bar light source of the gestalt 2 of operation.

[Drawing 6]
It is the perspective diagram of the light guide plate of the gestalt 2 of operation.

[Drawing 7]
It is the decomposition perspective diagram of the field luminescence equipment of the modification 1 concerning this invention.

[Drawing 8]
(a) is a ** type cross-sectional view for explaining the refraction in the diffusion section in the field luminescence equipment of this invention, and (b) is ** type drawing of longitudinal section for explaining th refraction in the diffusion section in the field lumin scence equipment of this invention.

[Drawing 9]
It is the perspective diagram of th light guide plate of the field lumin scenc equipment of the modification 2 concerning this invention.

[Drawing 10]

It is the cross section of the light guide plate of the field luminescence equipment of the modification 3 concerning this invention.

[Drawing 11]
It is the perspective diagram of the light guide plate of the field luminescence equipment of the modification 4 concerning this invention.

[Drawing 12]
It is the perspective diagram of the light guide plate of the field luminescence equipment of the modification 5 concerning this invention.

[Drawing 13]
It is the perspective diagram of the light guide plate of the field luminescence equipment of the modification 6 concerning this invention.

[Drawing 14]
Drawing 13 of the field luminescence equipment of the modification 6 concerning this invention is th perspective diagram of the light guide plate of different structure.

[Drawing 15]
It is the perspective diagram of the light guide plate of the field luminescence equipment of the modification 7 concerning this invention.

[Drawing 16]
Drawing 15 of the field luminescence equipment of the modification 7 concerning this invention is the perspective diagram of the light guide plate of different structure.

[Drawing 17]
It is drawing showing the luminescence state in the luminescence side of the light guide plate 1 of the field luminescence equipment concerning the gestalt 1 of this operation.

[Drawing 18]
It is drawing showing the luminescence state in the luminescence side of the light guide plate of the field luminescence equipment (conventional example) shown in drawing 19 .

[Drawing 19]
It is the plan of the field luminescence equipment of the conventional example.

[Drawing 20]
(a) is a ** type cross-sectional view for explaining the refraction in the diffusion section in the field luminescence equipment of the conventional example, and (b) is ** type drawing of longitudinal section for explaining the refraction in the diffusion section in the field luminescence equipment of the conventional example.

[Description of Notations]

1,101,501 -- Light guide plate
2 -- Light Emitting Diode light source,
3 -- Base material
4,103 -- Reflecting layer
10,104,504 -- End face of a light guide plate,
11, 111, 211, 311, 411,511,611,612 -- Optical diffusion section,
11a, 105,111a, 211a, 311a, 411a, 511a, 611a -- Notching
12 -- Luminescence side,

21 -- Light Emitting Diode chip (Light Emitting Diode element),
22 23a -- Leadframe
22a -- Cup
24 25,124 -- Translucency resin,
26,126 -- Outgoing radiation side,
100 -- Light Emitting Diode bar light source,
102 -- Light-emitting part
125 -- Bar book soma,
131 -- Crevice
505,505a -- Hollow.

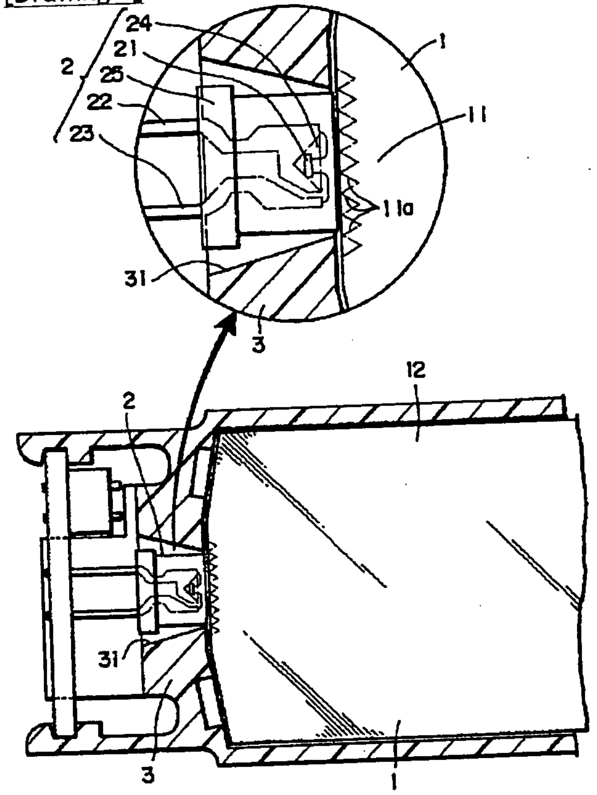
* NOTICES *

Japan Patent Office is not responsible for any
damages caused by the use of this translation.

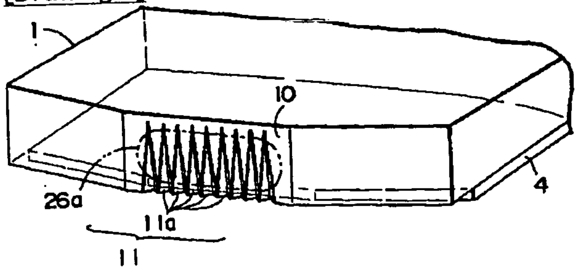
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

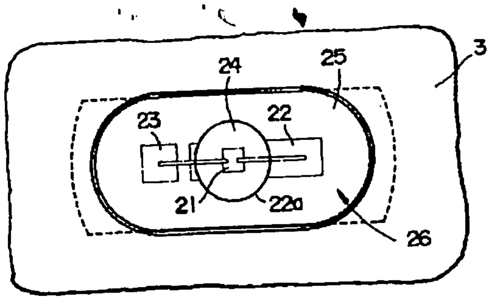
[Drawing 1]



[Drawing 2]



[Drawing 3]



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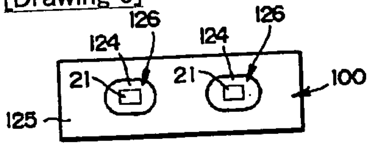

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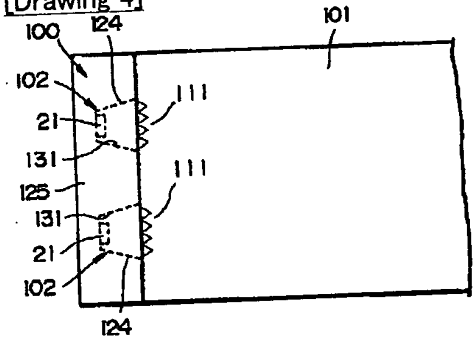

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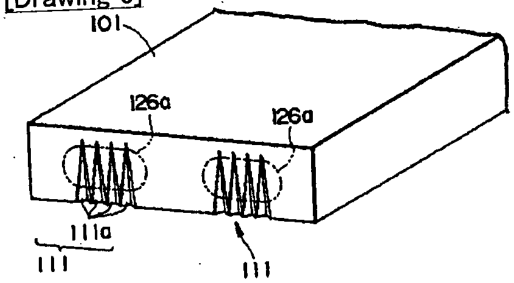

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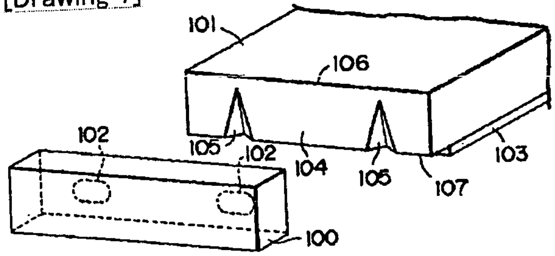

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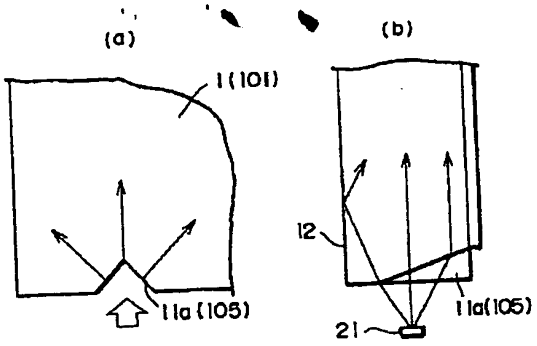

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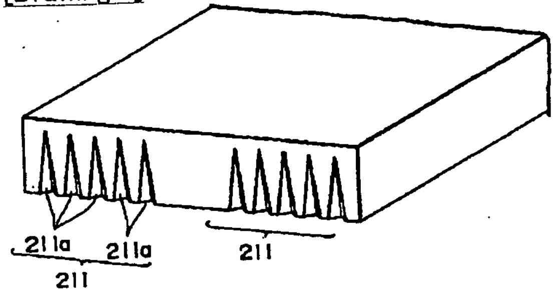
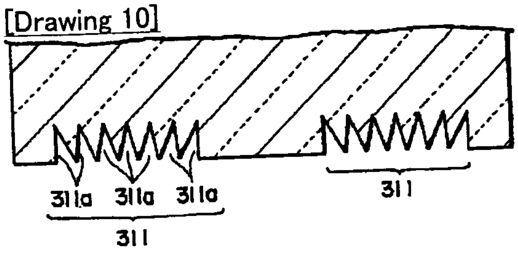
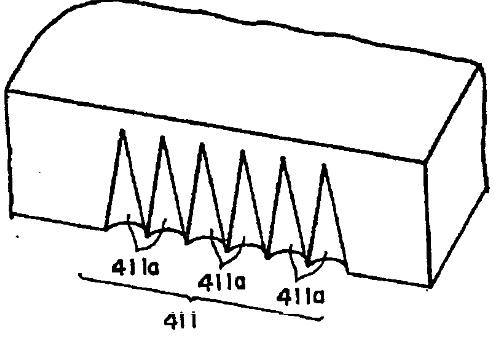


[Drawing 10]



[Drawing 11]



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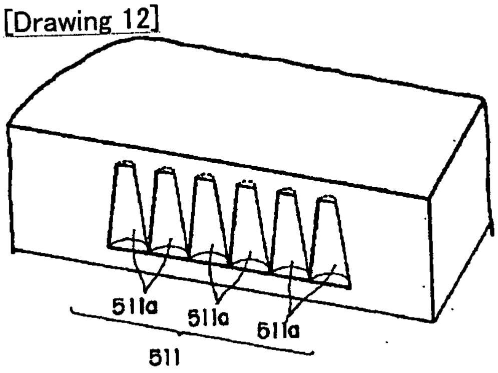
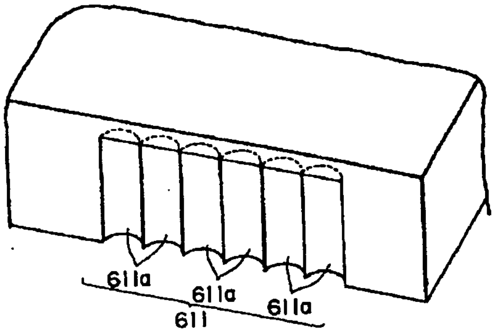


[Drawing 13]



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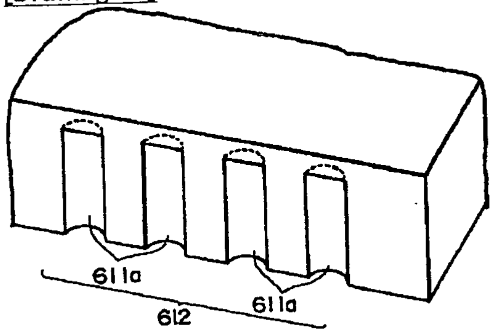

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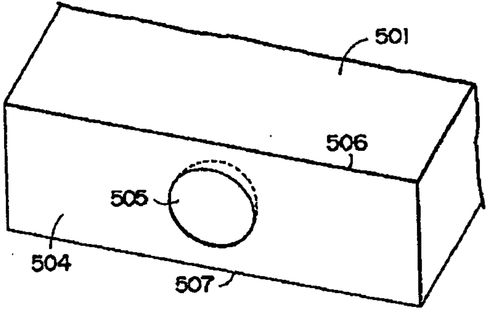
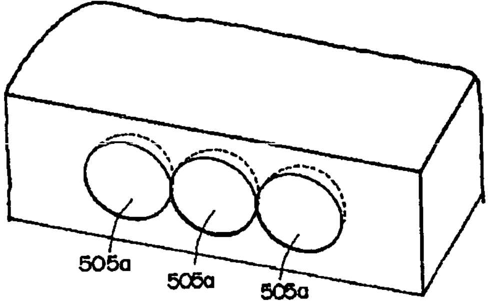
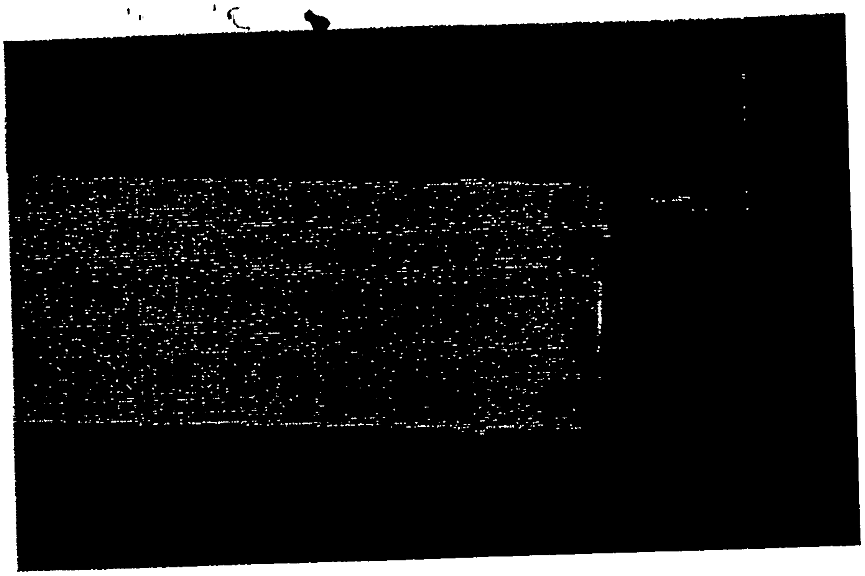


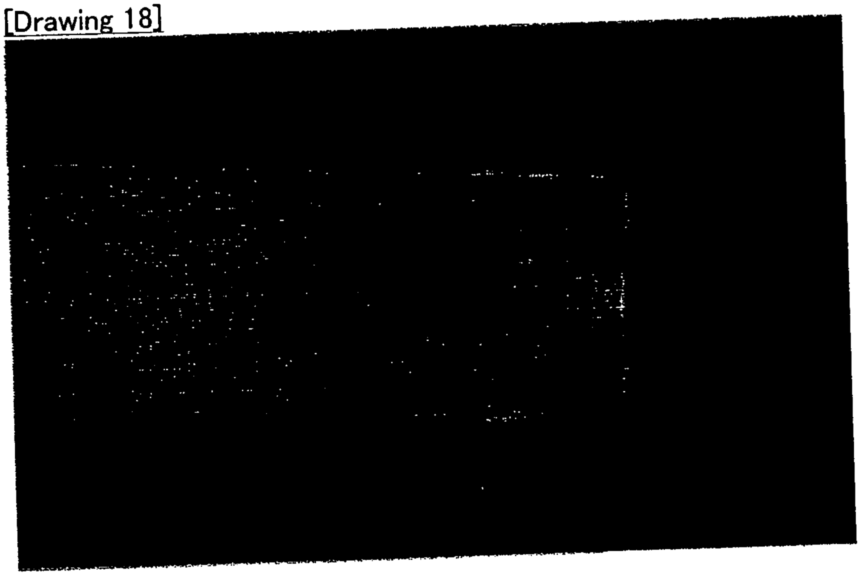
[Drawing 16]



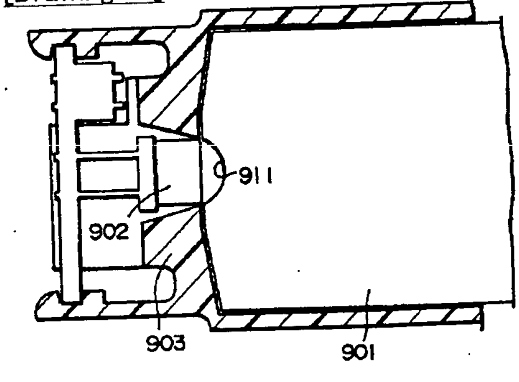
[Drawing 17]



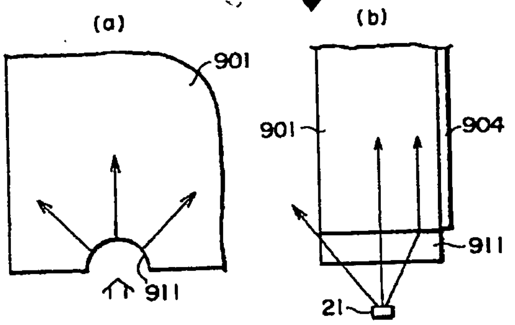
[Drawing 18]



[Drawing 19]



[Drawing 20]



[Translation done.]